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OIL AND HAZARDOUS MATERIALS. EMERGENCY
PROCEDURES IN THE WATER ENVIRONMENT

Federal Water Pollution Control Administration
Edison, New Jersey

October 1968

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WATER ENVIRONMENT**



Approved by
NATIONAL TECHNICAL
INFORMATION SERVICE

**U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
NORTHEAST REGION
NORTH ATLANTIC WATER QUALITY MANAGEMENT CENTER
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Oil & Hazardous Materials Included in First Edition

Acetaldehyde	Ethylene Diamine
Acetic Acid (Glacial)	2-Ethyl Hexanol
Acetic Anhydride	Formaldehyde Solutions
Acetone	Furfural
Acetonitrile	Gasoline
Acrylonitrile	Glycerine
Ammonia	Hydrochloric Acid
i-Amyl Acetate	Hydrofluoric Acid
Aniline	Hydrogen (Liquified)
Asphalt, Typical	Hydrogen Chloride
Benzene	Kerosine
Bunker "C"	Methyl Chloride
Butane	Methyl Ethyl Ketone
n-Butyl Alcohol	Naphthalene
Carbon Disulfide	Nitrogen Tetraoxide
Carbon Tetrachloride	Oleum
Caustic Potash Solution	Oxygen Difluoride
Caustic Soda Solutions	Phenol
Chlorine	Phosphoric Acid
Chloroform	Propane
Cresol	n-Propyl Alcohol
Crude Oil	Sulfur
Dieldrin	Sulfuric Acid
Diesel Oil	Tetraethyl Lead Compounds
Ethyl Alcohol	Toluene
	Xylene

Appendix

Cross Reference to Compounds

INTRODUCTION

The Clean Waters Restoration Act of 1966 assigned responsibility for the amended Oil Pollution Act of 1924 to the Secretary of the Interior. Subsequently, the President of the United States directed the Secretary of the Interior and the Secretary of Transportation to prepare a special study and report upon pollution of the Nation's waters by oil and hazardous materials. This report, also providing contingency planning in the event of significant spills, was completed in February 1968. These various activities in the Department of Interior are delegated to the Commissioner of the Federal Water Pollution Control Administration.

The Assistant Commissioner for Research and Development of the FWPCA has assigned responsibility for oil and hazardous materials research to the North Atlantic Water Quality Management Center located in Edison, New Jersey. The initial elements of the research program are currently under development. The first effort consists of an information and procedures manual on spills primarily intended for use in the FWPCA Regions. This manual will be expanded in the future to include many more significant hazardous substances. Comments and suggestions are desired from those having interest in this subject area and will be given serious consideration. This booklet will be revised and appended periodically as additional information is obtained.

PURPOSE

Very large amounts of petroleum and chemical products are shipped in bulk via waterways and by rail, truck and pipeline. The number and quantity of these materials is steadily increasing as industrial needs expand and advances are made in transportation technology. Spills and other accidental discharges of such products can seriously impair water uses proximate or remote from the source of discharge.

The purpose of this manual is to provide basic information on the characteristics and the effects of the pollutants and procedures to be followed in the event of a significant release of oil or other hazardous materials to the water environment. This booklet initially covers about 50 petroleum products and chemicals shipped in bulk. The data are intended for general guidance because it is impossible to provide tailor-made solutions on the diverse situations that may occur.

DESCRIPTION

This manual was prepared by the research staff at the North Atlantic Water Quality Management Center, FWPCA, Edison, New Jersey. Information was compiled from the following sources:

American Petroleum Institute, 1963, Manual on Disposal of Refinery Wastes, 7th Edition, V. 1 and 3: American Petroleum Institute, Division of Refining, New York.

Baker, Robert A., 1965, Threshold Odors of Organic Chemicals: Am. Water Works Assoc. Jour. 55, p. 913-916.

Gerarde, H. W., 1960, Toxicology and Biochemistry of Aromatic Hydrocarbons: New York, Elsevier.

Hager, Donald G. and Flentje, Martin E., 1965, Removal of Organic Contaminants by Granular-Carbon Filtration: Am. Water Works Assoc. Jour., 57, p. 1440-1450.

McKee, Jack E. and Wolfe, Harold W., Eds., 1963, Water Quality Criteria, 2nd Edition: Sacramento, California, State Water Quality Control Bd., Publication 3-A.

Sax, N. Irving, 1963, Dangerous Properties of Industrial Materials, 2nd Edition: New York, Reinhold.

Spector, William S., Ed., 1956, Handbook of Toxicology, Vol. 1: National Academy of Sciences: Philadelphia, Saunders.

U. S. Coast Guard, 1966, Chemical Data Guide for Bulk Shipment by Water, CG-388: Washington, U. S. Government Printing Office, 131 p.

The information for each material is classified into four categories:

1. Physical properties.
2. Data on water pollution hazard.
3. Water pollution control measures.
4. Data on hazard (fire and explosion, health and reactivity) in the immediate vicinity of incident.

A standard form is employed for each product for rapid reference and to group the data. Data sheets are arranged alphabetically by the most commonly-used chemical name. Since the data will be used by personnel with varying amounts of experience, non-technical terms are used whenever possible.

Physical Properties (Explanation of Terms)

Synonyms:

Alternate and common names are generally listed.

Formula:

A simplified structural formula is shown.

Specific Gravity:

The gravity of the weight of a volume of the liquid to the weight of an equal volume of water. In the case of liquids of limited solubility, specific gravity greater than one indicates that the product will sink, and a specific gravity of less than one shows that the product will float on fresh water.

Chemical Family:

Important in predicting compatibility of materials.

Boiling Point:

Given at a pressure of 760 mm Hg. which is equivalent to one atmosphere, or 14.7 psia.

Vapor Pressure:

Equilibrium pressure of the saturated vapor above the liquid at 20°C (68°F).

Vapor Density:

Ratio of the weight of the vapor or gas to that of an equal volume of air. Values less than one indicate that the vapor or gas will rise and values greater than one that it will settle. Temperature effects must be considered; e.g. methane at 20°C (68°F) has a vapor density of 0.6, whereas at its boiling point, -113 C (-172°F), the vapor is heavier than air, and will settle rather than rise.

Solubility in Water:

Solubility of the product in cold water is defined as follows:

Negligible	less than 0.1%
Slight	0.1% - 1%
Moderate	1% - 10%
Appreciable	more than 10%
Complete	in all proportions

The % by weight or parts per million (ppm) will be given when the solubility is deemed important.

Water Pollution Hazard Data

General guidance is provided on the effects of the material on aquatic life and important water uses, such as municipal and industrial supplies, commercial fishing, agriculture, and recreation. In many cases, particularly in diversified industrial usages, data is not sufficient to define other than general effects. Important effects are toxicity to man and mammals, aquatic life and vegetation; taste and odor; corrosion; and aesthetic and other problems.

The toxicity of a material may be immediately lethal or accumulative. There may also be synergism or antagonism with substances already in the water or a reaction with chemicals added during treatment. The toxic level for humans is ordinarily estimated from results of animal experimentation and normally expressed as LD₅₀, the single dose which will kill one-half of the animals in the test group. Chronic toxicity generally is not a problem with spills since the material will not remain in the vicinity sufficiently long. The toxicological effect of materials on aquatic life may be direct, or indirect by precipitating changes in the environment, and is normally expressed as TL_m, the concentration at which 50% of the aquatic animals can survive. In cases where protection against chronic toxicity is necessary, safety factors of 20 or more are applied to the TL_m values.

Substances in water may produce odors directly or by reactions with other materials through oxidation, reduction, etc. The products of these reactions may be more or less odorous than the original substance. The threshold odors of pure compounds may also be modified by synergistic or antagonistic effects. Taste-producing substances in water can be absorbed by the flesh of fish, making them inedible or at least unpleasantly flavored.

The effect of acid and alkali spills will be strongly influenced by the nature of the substance, degree of ionization, natural alkalinity, dilution available in the water body, and particular construction

materials comprising pipes, equipment and appurtenances coming in contact with the substance. Acids and alkalis may be toxic to the aquatic environment, harm crops, cause corrosion, impart taste to drinking water or irritate the skin of those using the water for recreational purposes.

Oil, foam and suspended matter may severely reduce the recreational value of waters, and also induce damage to fish and other aquatic life. Suspended solids, emulsified oil and color can cause many water supply problems in industry.

Water Pollution Control Measures

Numerous factors may be responsible for the concentration to be found in the critical zone and the degree of associated water pollution hazards. The more important factors include:

1. Quantity and type of material spilled.
2. Distance of spill from the use area.
3. Available dilution.
4. Type and nature of the water body.
5. Flow rate and tidal patterns.
6. Temperature.
7. Biodegradability and other properties of spilled material.
8. Effect of the material or reaction compounds on the water use.

Pollution control measures are intended as possible alternatives to denying a use until natural conditions dissipate the spilled material from the use area. Control measures would normally be applied when the concentration is low enough to permit effective and practical neutralization, removal or destruction of the pollutant. However, when the spill occurs relatively close to the use and the material is highly resistant to degradation or cannot be rapidly dispersed, the use may be denied until treatment measures can feasibly be employed.

Since the procedures are intended only as a guide, some judgment should be made in each case to assure the safest course of action. For example, it should be noted that many of the procedures listed for organic compounds are based on taste and odor controls because these threshold ranges apparently provide a large margin of safety compared to the toxic levels. However, toxic levels are generally derived from tests conducted with rats and other animals. As to taste and odor thresholds, there can be substantial variation among individuals tested,

conditions of the test, and effects of other compounds present in the water. Therefore, it is suggested that taste and odor measurement be conducted simultaneously with analytical measurement. If taste or odor are not detected but the concentration is above the maximum of the threshold range reported, the water use should be shut down and reopened only after careful consideration of the actual concentration and toxicological data shown under Pollution Hazard Data. In order to estimate a safe limit of concentration for compounds in water supplies where no such limit was previously established, safety factors of 100 to 1000 were applied to the LD₅₀ values. In certain cases, the water pollution control agency may decide to establish a concentration limit lower than the taste and odor thresholds shown herein.

Carbon treatment is the primary procedure recommended for removal of organic contaminants. Effectiveness of adsorption depends on the size and structure of the organic molecule and other factors. However, it appears that 12 to 24 inches of fresh activated carbon placed on top of the sand filter beds would be the most satisfactory treatment method for the organic materials given in the following sheets. Exhausted carbon is removed by backwashing the filter and collecting the material in a screen container. An alternate method is to slurry powdered carbon in water and to effect removal in the settling basins. Organic pollutants may also be removed by oxidation with chlorine or other oxidizing agents. Although breakthrough chlorination may be appropriate with some of the organics, carbon adsorption appears more generally applicable, dependable and practical.

When recreational activities may be affected, it is particularly important to immediately contact the state and local health departments for expediting necessary actions in the affected areas.

Fire & Explosion Hazard Data

Grades:

Liquids which burn are classified as follows:

- A. Flammable liquid with a flash point of 27°C (80°F) or below.
- B. Combustible liquid with a flash point above 27°C (80°F), but below 66°C (150°F).
- C. Combustible liquid with a flash point above 66°C (150°F).

Flash Point:

The temperature at which a liquid will give off sufficient flammable vapors to ignite. Values are open cup except where designated "c.c.", indicating closed cup values. The open cup values are generally about 6 to 11°C (10 to 15°F) higher than the c.c. determinations.

Flammable Limits:

Percent by volume in air of the gas or vapor which will burn or explode if an ignition source is present. Limiting concentrations are commonly called the "lower explosive limit" (LEL) and the "upper explosive limit" (UEL). Below the LEL the mixture is too lean to burn, and above the UEL the mixture is too rich.

Autoignition Temperatures:

Minimum temperature required to ignite the gas or vapor without a spark or flame being present. Values given are only approximate and may vary substantially with change in geometry, gas or vapor concentrations, presence of catalysts, or other factors.

Extinguishing Media:

Various firefighting agents may be suitable for use on the burning material. Specific formulations are not mentioned in this report because of the large number of these available under various trade names. The general firefighting agents are listed as follows:

Water fog - a finely-divided mist produced by high or low-velocity fog nozzles used for knocking down flames and cooling hot surfaces.

Foam - mechanical or chemical foam produced by a special foam nozzle or by a fixed system used to form a sufficient blanket over the surface of burning liquids. Foam is effective only with liquids which do not mix with water.

Alcohol foam - this material functions similar to conventional foam, but is intended for use with liquids that mix with water, such as alcohol, acetone, etc. Alcohol foam must be more carefully applied than regular foam because the bubbles have a lower mechanical strength.

CO₂ - Carbon dioxide gas stored in cylinders and applied manually through fixed or semi-fixed systems; is used for extinguishing small fires or inerting and sealing from reentering air.

Dry chemical - sodium or potassium bicarbonate powder is dispersed from semi-fixed or portable extinguishers.

Special Fire Procedures:

Certain precautions to be observed because of unusual properties of the materials under firefighting conditions, e.g., formation of toxic combustion products, reactivity with extinguishing media, protective clothing, etc.

For large-scale chemical fires aboard a vessel, water would probably be used in preference to more effective agents, because of its unlimited availability. Water should also be used to cool tanks containing chemicals to prevent their ignition or explosion and tank rupture. Water would not be employed when violent reaction between a chemical and water may occur.

Health Hazard Data

A substance is given a numerical rating based upon practical considerations which consider the effect apart from the means by which the effect is produced. Certain materials are dangerous because they are systemic poisons whereas others are, strictly speaking, irritants or corrosive in nature. This rating particularly recognizes inhalation and physical contact hazards. The rating describes effects of a single exposure, although many substances produce chronic effects after repeated exposures over a protracted period of time. These are not listed because they are not normally experienced during a spill. The following toxic rating is employed:

Toxic Rating:

- 0 - Nontoxic
- 1 - Practically nontoxic
- 2 - Slightly toxic
- 3 - Moderately toxic
- 4 - Highly toxic

Odor Threshold:

The minimum concentration of a substance volume in air that can be detected by smell by most people. Odor thresholds will vary between individuals and from day-to-day for any one person. Also, the odor of a potentially dangerous vapor may be masked by other odors. Certain vapors produce olfactory fatigue which is a deadening of the sense of smell. For these reasons, the threshold odor alone is not a reliable indicator of the presence or absence of dangerous vapors.

Threshold Limit Value (TLV):

Concentration of a substance volume in air believed to be safe for eight hours daily exposure on a continuous basis. The susceptibility of individuals will vary and the values given in this report are those accepted by the American Conference of Governmental Industrial Hygienists (ACGIH) for 1965. These values should NOT be used to compare the relative toxicities of different materials.

Short Exposure Tolerance:

Gas and vapor concentrations of a substance volume in air which should not be exceeded for the exposure times specified. In many cases there is limited data on human exposure.

Exposure Procedures:

First aid procedures recommended by manufacturers, safety organizations, and others, which are emergency procedures only. The victim should be examined by a physician as soon as possible after exposure.

Reactivity Data

Stability:

The susceptibility of the product to dangerous reactions when exposed to conditions such as high temperature, shock, oxidizing agents, etc.

Compatability:

The inertness or reactivity of the substance with other material it is likely to contact. This list is by no means complete or all inclusive. In certain cases small quantities of the material may act as a catalyst producing violent reactions such as polymerization, dissociation, condensation, etc. Catalysts, when known, are noted.

ACETALDEHYDE

Synonyms	: Ethanal	Formula.....CH ₃ CHO
Appearance-Odor:	Colorless liquid; pungent suffocating odor; fruity odor when dilute	Boiling Point.....20.2°C(69.4°F) Vapor Pressure.....755 mm Hg Vapor Density.....1.52 Freezing Point.....-123.5°C(-186°F) Solubility in Water..Complete Specific Gravity... .0.78
Chemical Family:	Aldehyde	

POLLUTION HAZARD DATA

Aquatic Life	A 24-hour TLM of 70 mg/l is reported for marine perch and the maximum concentration at which no deaths occurred is 60 mg/l. With bluegill sunfish in soft water at 18-20°C, a 96-hour TLM of 53 mg/l is reported.
Domestic Use	Oral LD ₅₀ for rats reported as 1.93 g/kg of body weight.
Agricultural Use	Insufficient information to determine hazard.
Industrial Uses	Substance may cause taste, odor or other problems depending on particular use.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below 20 mg/l as well as the taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade	A
Flash Point	-37.8°C(-36°F)cc.
Flammable Limits, %	4.0-57
Autoignition Temp	185°C(365°F)
Extinguishing Media	CO ₂ , dry chemical, alcohol foam, water fog.
Special Fire Procedures	Avoid exposure to vapors. Cool tank with water spray.
General	If pressure is used to unload tank, nitrogen or other inert gas must be used. Air under pressure may cause explosive peroxides to form. In case of spill, secure ignition sources.

HEALTH HAZARD DATA

Toxic Rating: 3	Odor Threshold (ppm): 2.3	TLV (ppm): 200
Toxic Characteristics	Irritates eyes and respiratory tract. Prolonged exposure to high vapor concentrations will cause eye burns.	
Symptoms	Burning of eyes, nose and throat; headache, rapid heartbeat.	
Short Exposure Tolerance	1,100 ppm for 2 hours is severely irritating to mucous membranes. 11,000 ppm for 1-2 hours has been reported as fatal.	
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.	
General	Avoid contact with liquid chemical.	

REACTIVITY DATA

Stability	Highly reactive. Can form explosive peroxide under air pressure. Slowly polymerizes to paraldehyde. Can react vigorously with oxidizing materials.
Compatibility	Little or no corrosion of mild steel. May dissolve rubber.

ACETIC ACID (Glacial)

Synonyms : Ethanoic acid,
vinegar acid

Appearance-Odor: Colorless liquid;
pungent vinegar-like odor

Chemical Family: Acid

Formula..... CH_3COOH
Boiling Point..... $118.1^\circ\text{C}(240^\circ\text{F})$
Vapor Pressure.....11.3 mm Hg
Vapor Density.....2.07
Freezing Point..... $16.6^\circ\text{C}(62^\circ\text{F})$
Solubility in Water....Complete
Specific Gravity.....1.05

POLLUTION HAZARD DATA

Aquatic Life	Fish can stand 5000 mg/l of acetic acid for short periods. For long exposures much lower concentrations are lethal. Acetic acid can be toxic to fish without lowering the pH value to 5, as toxicity appears to be attributable primarily to the undissociated acid in water. Hardness appears to be antagonistic to the toxicity of acetic acid. Concentrations as low as 50 mg/l have been reported as lethal to fish in a 24-hour period. Acetates appear to be much less toxic than undissociated acetic acid.
Domestic Use	The odor threshold of acetic acid is 5 to 80 mg/l in drinking water. Acetates impart a taste to drinking water at the 300 to 1000 mg/l level. Oral LD_{50} of acetic acid for rats has been reported as 3.31 g/kg and for mice 4.46 g/kg of body weight.
Agricultural Use	Low pH may be detrimental depending on soil and crop.
Industrial Uses	May cause corrosion in metal pipes and equipment.

POLLUTION CONTROL MEASURES

Domestic Supply	Neutralize with sufficient alkali to prevent taste and odor, corrosion or interference with water treatment. Acetates appear to be much less toxic than undissociated acetic acid and have higher taste threshold levels. Treat with sufficient powdered or activated carbon to reduce concentration below taste and odor threshold level. Polish off with neutralization if necessary.
Agriculture	Neutralize with sufficient alkali, if necessary.

Industry Treat as described above where corrosion may occur and in industries that will be adversely affected by taste and odor (food, beverage, etc.) or excessive acetate concentration.

FIRE & EXPLOSION HAZARD DATA

Grade.....B
Flash Point.....40°C(104°F)
Flammable Limits, %.....5.4-16 at 100°C (212°F)
Autoignition Temp.....427°C (800°F)
Extinguishing Media.....CO₂, dry chemical, alcohol foam, water fog.
Special Fire Procedures....Use personal protective equipment when contact with liquid is likely. Skin or clothing contact can cause serious burns.

HEALTH HAZARD DATA

Toxic Rating: 4*	Odor Threshold (ppm): below 10	TLV (ppm): 50
Toxic Characteristics	Inhalation of vapors is harmful. Contact with glacial acid can cause severe burns to skin and eyes.	
Symptoms	Burning of skin in contact with liquid. Irritation of eyes and respiratory system.	
Short Exposure Tolerance	Extreme irritation is effected by 200-500 ppm. This concentration may be tolerated by some individuals for a short time.	
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical attention.	

REACTIVITY DATA

Stability	Can react vigorously with oxidizing materials.
Compatibility	Highly corrosive to metals when dilute. 316 and 318 stainless steels and aluminum are satisfactory construction materials.

Remarks: Note that the freezing point is 16.6°C(62°F). Below this temperature the acid may freeze and burst its container.

*The toxicity rating is due to the corrosive properties of the acid.

ACETIC ANHYDRIDE

Synonyms	: Acetic oxide	Formula.....	(CH ₃ CO) ₂ O
Appearance-Odor:	Colorless liquid; pungent, highly irritating odor	Boiling Point.....	140°C(284°F)
Chemical Family:	Acid anhydride	Vapor Pressure.....	4 mm Hg
		Vapor Density.....	3.5
		Freezing Point.....	-73°C(-100°F)
		Solubility in Water..	12%
		Specific Gravity.....	1.08

POLLUTION HAZARD DATA

Aquatic Life	See acetic acid.
Domestic Use	See acetic acid.
Agricultural Use	See acetic acid.
Industrial Uses	See acetic acid.

POLLUTION CONTROL MEASURES

Domestic Supply	See acetic acid (material decomposes to acetic acid in water).
Agriculture	See acetic acid.
Industry	See acetic acid.

FIRE & EXPLOSION HAZARD DATA

Grade.....	B
Flash Point.....	54°C(130°F)
Flammable Limits, %.....	2.7-10
Autoignition Temp.....	400°C(752°F)
Special Fire Procedures.....	Cool outside of tanks with water spray. Apply water cautiously. DO NOT contaminate anhydride system with water. Use self-contained respiratory protection and protective clothing.
General.....	Reacts vigorously with water generating dangerous heat and pressure in confined spaces.

HEALTH HAZARD DATA

Toxic Rating: 4	Odor Threshold (ppm)	TLV (ppm) 5
Toxic Characteristics	Vapors highly irritating to eyes and mucous membranes. Liquid is corrosive to living tissue. Eye, respiratory and body protection are required when exposed to vapor or liquid.	
Symptoms	Coughing; burning sensation in nose and throat. Severe eye and skin burns.	
Short Exposure Tolerance		
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical attention.	

REACTIVITY DATA

Stability	Reacts with water to form acetic acid and produces considerable heat.
Compatibility	Highly corrosive to iron and steel when moist. Softens many plastics. Usually stored in aluminum or stainless steel tanks. Avoid getting water into anhydride tanks. Reacts with water to form Acetic Acid.

ACETONE

Synonyms ketone	: Propanone, dimethyl	Formula..... CH_3COCH_3
		Boiling Point..... $56.2^\circ\text{C}(134^\circ\text{F})$
		Vapor Pressure.....180 mm Hg
Appearance-Odor:	Colorless liquid;	Vapor Density.....2.0
	sweetish odor	Freezing Point..... $-94.8^\circ\text{C}(-139^\circ\text{F})$
Chemical Family:	Ketone	Solubility in Water..Complete
		Specific Gravity.....0.79

POLLUTION HAZARD DATA

Aquatic Life	Threshold concentrations for immobilization of miscellaneous fish reported to be about 14,000 mg/l.
Domestic Use	Oral LD ₅₀ values reported as 5.34 and 9.75 g/kg of body weight for rats and rabbits, respectively. Odor threshold concentrations are from 1 to 300 mg/l.
Agricultural Use	Insufficient information available to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems depending on use.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above in industries where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....	A
Flash Point.....	$-9.4^\circ\text{C}(15^\circ\text{F})$
Flammable Limits, %.....	2.6 - 12.8
Autoignition Temp.....	$560^\circ\text{C}(1040^\circ\text{F})$
Extinguishing Media.....	CO_2 , dry chemical, alcohol foam, water fog.
Special Fire Procedures.....	If water is used, large quantities must be applied in order to prevent re-ignition. A solution of 4% acetone and 96% water has a flash point of $54^\circ\text{C}(120^\circ\text{F})$. Shut down ignition sources. Do not flush into confined space such as a sewer because of danger of explosion.

HEALTH HAZARD DATA

Toxic Rating: 1 Odor Threshold (ppm): 200-400 TLV (ppm): 1000

Toxic Characteristics

Symptoms	Drowsiness and throat irritation.
Short Exposure Tolerance	10,000 ppm has been reported as endurable for 30-60 minutes without symptoms.
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability	Stable compound.
Compatibility	Will dissolve many plastics.

ACETONITRILE

Synonyms	: Methyl cyanide, ethanenitrile	Formula..... CH_3CN
Appearance-Odor:	Colorless liquid, aromatic odor	Boiling Point..... $80.1^\circ\text{C}(178^\circ\text{F})$
Chemical Family:	Nitrile	Vapor Pressure.....73 mm Hg
		Vapor Density.....1.41
		Freezing Point..... $-41^\circ\text{C}(-40^\circ\text{F})$
		Solubility in Water..Complete
		Specific Gravity.....0.78

POLLUTION HAZARD DATA

Aquatic Life	Bioassays conducted with a variety of fish showed 24-hour TLM values from 1150 to 1650 mg/l in hard and soft water saturated with oxygen. No taste effects were noted with adult bluegills exposed up to 4 weeks in water containing 100 mg/l of acetonitrile.
Domestic Use	An oral LD_{50} value of 3.8 g/kg of body weight has been reported for rats. Acetonitrile can dissociate to cyanide; USPHS Drinking Water Standards set a recommended limit of 0.01 mg/l and a mandatory limit of 0.2 mg/l for cyanide.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below 0.5 mg/l as well as the taste and odor threshold level. If associated cyanide concentration is above 0.1 mg/l shut down water supply.
Agriculture	Hazard undetermined.
Industry	Treat as described above in industries that may be adversely affected such as food and beverage. If associated cyanide is above 0.1 mg/l shut off supply.

FIRE & EXPLOSION HAZARD DATA

Grade.....	A
Flash Point.....	$5.6^\circ\text{C}(42^\circ\text{F})$
Flammable Limits, %.....	unknown
Autoignition Temp.....	unknown
Extinguishing Media.....	CO_2 , dry chemical, alcohol foam

Special Fire Procedures....Care must be taken not to expose fire fighters to the fumes of this material. Any who must enter a contaminated atmosphere must be provided with respiratory protection. Cool tank with water spray. Secure ignition sources.

General.....Reacts with water, steam and acids to produce toxic and flammable vapors.

HEALTH HAZARD DATA

Toxic Rating: 3	Odor Threshold (ppm): 40*	TLV (ppm): 40
Toxic Characteristics	Toxic amounts of concentrated solution may be absorbed through the skin.	
Symptoms	Dizziness, headache, nausea, and blueness of the lips and fingernails.	
Short Exposure Tolerance	Brief exposure to 500 ppm has produced some nose and throat irritation.	
Exposure Procedures	Remove victim to fresh air. Apply artificial respiration if he stops breathing. Get medical attention. If liquid contacts skin, wash off with plenty of water.	

REACTIVITY DATA

Stability	See fire and explosion hazard data.
Compatibility	

Remarks: *NOTE: Odor threshold is not considered adequate warning of potentially dangerous vapor concentrations.

Users of ACETONITRILE should have readily available for the doctor a kit containing the following items:

- 1 sterile syringe, 10 cc.
- 1 sterile syringe, 50 cc.
- 2 ampules of sodium nitrite (10 cc., 3% solution)
- 2 ampules of sodium thiosulfate (50 cc., 23% solution)
- 12 pearls of amyl nitrite

If cyanide vapors are inhaled, break an amyl nitrite pearl in a cloth

and hold it lightly under the nose of the victim (but away from the person giving first aid) for 15 seconds. Repeat five times at about 15 second intervals.

ACRYLONITRILE

Synonyms : Vinyl cyanide,
propenenitrile

Appearance-Odor : Colorless liquid;
odor resembles that of peach seed
kernels

Formula..... CH_2CHCN
Boiling Point..... $77.3^\circ\text{C}(171^\circ\text{F})$
Vapor Pressure.....83 mm Hg
Vapor Density.....1.8
Freezing Point..... $-83^\circ\text{C}(-117^\circ\text{F})$
Solubility in Water..3%
Specific Gravity.....0.81

Chemical Family : Nitrile

POLLUTION HAZARD DATA

Aquatic Life Fish had a lower tolerance limit of 20-25 mg/l, and all fish were killed within 24 hours by 100 mg/l. It has been found that 10-25 mg/l of acrylonitrile did not interfere with mixed biota in stream purifications but at 50 mg/l the growth was predominately fungal. No taste effects were apparent with adult bluegills exposed up to 4 weeks in water containing 5 mg/l of acrylonitrile.

Domestic Use Oral LD₅₀ values of 0.09 and 0.05 g/kg of body weight have been reported for rats and guinea pigs, respectively. Acrylonitrile can dissociate to cyanide. USPHS Drinking Water Standards set a recommended limit of 0.01 mg/l and a mandatory limit of 0.2 mg/l for cyanide in water.

Agricultural Use Insufficient information to establish hazard.

Industrial Uses Substance may cause taste, odor or other problems.

POLLUTION CONTROL MEASURES

Domestic Supply Treat with sufficient powdered or activated carbon to reduce concentration below 0.5 mg/l as well as the taste and odor threshold level. If associated cyanide concentration is above 0.1 mg/l, shut down water supply.

Agriculture Hazard undetermined.

Industry Treat as described above in industries that may be adversely affected such as food and beverage. If associated cyanide is above 0.1 mg/l, shut off supply.

FIRE & EXPLOSION HAZARD DATA

Grade.....A
Flash Point..... $0^\circ\text{C}(32^\circ\text{F})$
Flammable Limits, %.....3.0 - 17.0
Autoignition Temp..... $480^\circ\text{C}(898^\circ\text{F})$

Extinguishing Media.....CO₂, dry chemical, alcohol foam
Special Fire Procedures....DO NOT use dry chemical for a large, confined fire.
Fire parties must wear respiratory protection.
Keep tank cool with water spray. Secure ignition sources.
General.....When heated this material may evolve toxic cyanide gas, or explode, or both. Must be inhibited prior to bulk shipment.

HEALTH HAZARD DATA

Toxic Rating: 4	Odor Threshold (ppm): *	TLV (ppm): 20
Toxic Characteristics	May be absorbed through the skin. Contact with skin may also cause dermatitis.	
Symptoms	Eye irritation, headache, nausea, blueness of lips and fingertips.	
Short Exposure Tolerance		
Exposure Procedures	Remove victim to fresh air. If he is not breathing, apply artificial respiration. Remove contaminated clothing and wash chemical from skin with a gentle flow of water. Get medical attention.	

REACTIVITY DATA

Stability	Sensitive to light. Very reactive; may polymerize explosively in the presence of strong bases.
Compatibility	Copper and copper alloys are attacked and should not be used. This material penetrates leather, so contaminated leather shoes and gloves should be destroyed.

Remarks: *Dulls sense of smell; odor is not reliable to indicate potentially dangerous vapor concentrations.

Users of ACRYLONITRILE should have readily available for the doctor a kit containing the following items:

- 1 sterile syringe, 10 cc.
- 1 sterile syringe, 50 cc.
- 2 ampules of sodium nitrite (10 cc., 3% solution)

2 ampules of sodium thiosulfate (50 cc., 25% solution)
12 pearls of amyl nitrite.

If acrylonitrile is inhaled, break an amyl pearl in a cloth and hold it lightly under the nose of the victim (but away from the person giving first aid) for 15 seconds. Repeat five times at about 15 second intervals.

AMMONIA

Synonyms

Appearance-Odor: Colorless liquid or gas; pungent, highly irritating odor

Chemical Family: Alkali

Formula..... NH_3
Boiling Point..... $-33^\circ\text{C}(-36^\circ\text{F})$
Vapor Pressure.....6428 mm Hg
Vapor Density.....0.6
Freezing Point..... $-78^\circ\text{C}(-107.9^\circ\text{F})$
Solubility in Water.....10%
Specific Gravity.....liquid at B.P.
0.67

POLLUTION HAZARD DATA

Aquatic Life

Anhydrous ammonia reacts with water to form ammonium hydroxide which in turn ionizes to give a high pH. Upper pH limit tolerated by most fresh-water fish is 8.4 and algae are destroyed above 8.5. Ammonia concentrations as low as 2.5 mg/l are harmful to fish at pH 7.4 to 8.5. In brackish waters, oyster larvae have been injured at pH 9 and die at pH 9.1 in a few hours. For crabs, the upper limit of pH has been found to be 10.2.

Domestic Use

The odor threshold for ammonia is reported as 0.034 mg/l in water. Coffee taste has been found to be affected at 34 mg/l.

Agricultural Use

Excessive alkalinity in irrigation water can be detrimental depending on type of crop and physical and chemical properties of soil. High alkalinities in water have been detrimental to stock. When caustic alkalinity reaches 50 mg/l, trouble with diarrhea in chickens begins, and at a total alkalinity of 170 mg/l, animals were reported to develop diarrhea.

Industrial Use

Alkalinity can cause corrosion of aluminum, tin or lead parts or equipment, and is detrimental in many processes, especially those involving the production of food and beverages. The range of recommended threshold values for total alkalinities in water supplies are: brewing 75-150 mg/l, carbonated beverages 50-170 mg/l, food products 30-250 mg/l, and pulp and paper making 45-150 mg/l. An ammonia content above 5 mg/l in water will corrode copper.

POLLUTION CONTROL MEASURES

Domestic Supply

Apply breakthrough chlorination if practical with particular water (activated carbon treatment may also be helpful).

Agriculture	Generally no problem. Temporarily shut off supply or neutralize where pH increase may be detrimental.
Industry	Temporarily shut off supply or treat to reduce below level that would corrode copper equipment or adversely affect processing operation.

FIRE & EXPLOSION HAZARD DATA

Grade.....	Liquified compressed gas
Flash Point.....	indefinite
Flammable Limits, %.....	16-25
Autoignition Temp.....	79°C, 1204°F
Extinguishing Media.....	Stop flow of gas; cool tank with water spray.
Special Fire Procedures....	Use respiratory and body protection when approaching ammonia-contaminated atmosphere. Liberal use of water fog, where possible, will reduce vapor concentration.
General.....	Some fire hazard in high concentrations and at high temperature. Oil or other combustible vapors increase the fire hazard. The explosive range is extended by increases in temperature and pressure. In case of rupture, secure ignition sources. Evacuate all unprotected personnel.

HEALTH HAZARD DATA

Toxic Rating: 4	Odor Threshold (ppm): approx 50	TLV (ppm): 50
Toxic Characteristics	Both liquid and gas are strong irritants and are severely corrosive to respiratory and other body tissue. Contact with liquid causes severe frostbite.	
Symptoms	Coughing; burning sensation, eye irritation or pain. Frozen areas turn white.	
Short Exposure Tolerance	A 2500 ppm (0.25%) concentration of ammonia in air is dangerous for 30 minutes exposure.	
Exposure Procedures	Remove victim to fresh air. Flush affected area of body with plenty of water for 15 minutes. DO NOT FLUSH FROZEN AREAS. Remove contaminated clothing and shoes. Get prompt medical attention. Low-velocity fog is effective for decontaminating the atmosphere.	

REACTIVITY DATA

Stability	Normally stable. Reacts with acid materials.
Compatibility	Corrosive to galvanized surfaces, copper and copper alloys. Iron and steel are suitable for the construction of containers, fittings and piping.

Remarks: Coast Guard Regulations require a warning sign to be displayed by barges carrying this commodity. The following is an example of acceptable wording:

DANGER: ANHYDROUS AMMONIA

NONFLAMMABLE COMPRESSED GAS

TOXIC - NO VISITORS

NO SMOKING OR OPEN LIGHTS

i-AMYL ACETATE

Synonyms	: Banana oil, pear oil	Formula..... $\text{CH}_3\text{COO}(\text{CH}_2)_2\text{CH}(\text{CH}_3)_2$
Appearance-Odor	: Colorless liquid; pleasant fruity, banana-like odor	Boiling Point.... $142^\circ\text{C}(290^\circ\text{F})$ Vapor Pressure...5 mm Hg at 25°C Vapor Density....4.5 Freezing Point... $-70^\circ\text{C}(-94^\circ\text{F})$
Chemical Family	: Ester	Solubility in Water..0.25% Specific Gravity.....0.88

POLLUTION HAZARD DATA

Aquatic Life	Toxicity tests with creek chub, a fish considered to be average in tolerance, showed that all four test fish lived for 24 hours at concentrations of 50 mg/l or less, and all died at concentrations exceeding 120 mg/l.
Domestic Use	The threshold odor has been reported as 0.002 to 0.86 mg/l of amyl acetate in water. Oral LD_{50} of 6.5 g/kg of body weight for rats has been reported.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems depending on use.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above, where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....	A
Flash Point.....	$25^\circ\text{C}(77^\circ\text{F})$
Flammable Limits, %.....	1.1 - 7.5
Autoignition Temp.....	$379^\circ\text{C}(714^\circ\text{F})$
Extinguishing Media.....	CO_2 , dry chemical, alcohol foam, water fog.
Special Fire Procedures....	
General.....	Secure ignition sources in case of spill.

HEALTH HAZARD DATA

Toxic Rating: 2	Odor Threshold (ppm): 7-10	TLV (ppm): 200
Toxic Characteristics	The odor of iso-amyl acetate may disguise the presence of other toxic vapors in the area.	
Symptoms	Headache, dizziness, nausea.	
Short Exposure Tolerance	Irritation to eyes and respiratory tract occurs at 500-1,000 ppm in 30-60 minutes.	
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.	

REACTIVITY DATA

Stability	Chemically stable.
Compatibility	This compound will soften, then dissolve, many plastic materials.

ANILINE

Synonyms	: Aniline oil, phenylamine, aminobenzene	Formula..... $C_6H_5NH_2$
Appearance-Odor	: Oily colorless-to brown liquid; odor not unpleasant	Boiling Point..... $184.4^{\circ}C(364^{\circ}F)$
Chemical Family	: Amine	Vapor Pressure.....2.4 mm Hg
		Vapor Density.....3.22
		Freezing Point..... $-6.2^{\circ}C(21^{\circ}F)$
		Solubility in Water...4%
		Specific Gravity.....1.02

POLLUTION HAZARD DATA

Aquatic Life	Toxic levels have been reported as 100-1,100 mg/l for fish.
Domestic Use	A maximum allowable concentration in water has been given as 5.0 mg/l. The oral LD ₅₀ for dogs is 500 mg/kg of body weight. The odor threshold level has been found to be 2-128 mg/l in water.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems depending on use.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below 5 mg/l as well as the taste or odor threshold level.
Agriculture	Hazard undetermined
Industry	Treat as described above where material will cause a taste, odor or other problem.

FIRE & EXPLOSION HAZARD DATA

Grade.....	C
Flash Point.....	$76^{\circ}C(168^{\circ}F)$
Flammable Limits, %.....	LEL 1.3; UEL not listed
Autoignition Temp.....	$562^{\circ}C(1143^{\circ}F)$
Extinguishing Media.....	CO_2 , dry chemical, alcohol foam, water spray
Special Fire Procedures....	Protect personnel against exposure to either the vapor or liquid.
General.....	In case of spill, secure ignition sources. Vapor and liquid is poisonous.

HEALTH HAZARD DATA

Toxic Rating: 4 Odor Threshold (ppm): approx. 0.5 TLV (ppm): 5

Toxic Characteristics Class B poison. Readily absorbed through the skin. Anemic persons and heavy drinkers are especially susceptible. May also cause allergic reactions.

Symptoms Headache, weakness, irritability, dizziness, bluish discoloration of lips and fingernails, drowsiness, and unconsciousness.

Short Exposure Tolerance Concentration of 50-100 ppm probably can be tolerated for 60 minutes.

Exposure Procedures Remove victim to fresh air. Apply artificial respiration if needed. Remove any clothing wet with aniline. Flush exposed skin area thoroughly with water. Get medical attention as soon as possible. Administer oxygen if available. Keep patient at rest.

REACTIVITY DATA

Stability Gives off toxic fumes when heated.

Compatibility Reacts with oxidizing materials. Rubber is suitable for protective clothing. Not corrosive to iron or steel.

Remarks: Coast Guard Regulations require a warning sign to be displayed by barges carrying this commodity. The following is an example of acceptable wording:

DANGER! ANILINE

COMBUSTIBLE "B" POISON

NO VISITORS

NO SMOKING OR OPEN LIGHTS

ASPHALT, Typical

Synonyms	: Petroleum pitch	Formula.....
Appearance-Odor:	Thick brown-to-black semisolid; tarry odor	Boiling Point.....>700°C(>1300°F)
Chemical Family:	Hydrocarbon	Vapor Pressure.....varies
		Vapor Density.....varies
		Freezing Point.....varies
		Solubility in Water..negligible
		Specific Gravity.....0.9 - 1.1

POLLUTION HAZARD DATA

Aquatic Life	Material may adhere to the gills of fish and interfere with respiration. Asphalt sinking to bottom may retard growth of bottom organisms, or interfere with spawning areas. Water soluble components may be harmful to fish or fishfood organisms, or affect the taste of fish flesh. Floating or suspended material may interfere with photosynthesis.
Domestic Use	Taste and odor may be imparted to drinking water source by soluble components, or effectiveness of water treatment process may be decreased by insoluble suspended material.
Agricultural Use	Asphalt may accumulate in distribution system reducing its capacity.
Industrial Uses	Major deleterious effect is that soluble components may impart a taste and odor to manufactured products. Processes where this may occur include brewing, carbonated beverages, food canning and freezing, sugar production, and food equipment washing.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to prevent taste and odor problems. Temporarily shut off supply if quantity of suspended material interferes with water treatment.
Agriculture	Temporarily shut off supply when large amount of suspended material is present.
Industry	Treat with activated carbon in those industries such as brewing, carbonated beverages, food canning and sugar production, which are affected by taste and odor.

Temporarily shut off supply if suspended material is present in sufficient concentration to interfere with operation.

FIRE & EXPLOSION HAZARD DATA

Grade.....Varies with composition.
Flash Point.....10-200°C(50-400°F) depending on grade of asphalt.
Flammable Limits, %.....varies
Autoignition Temp.....480°C(905°F)
Extinguishing Media.....CO₂, dry chemical, foam, water fog.
Special Fire Procedures....Water spray or foam may be ineffective because of frothing; apply cautiously. DO NOT direct a solid stream of water into hot asphalt.
General.....There are many grades of asphalt, each with different properties. If asphalt heated above 212°F is spilled into water, persons nearby risk being scalded by the steam or hot water formed. Most grades of asphalt will present little or no problem if spilled.

HEALTH HAZARD DATA

Toxic Ratings: 1	Odor Threshold (ppm):	TLV (ppm):
Toxic Characteristics	Vapors are strong and unpleasant. Hot liquid asphalt can cause serious burns with a possibility of skin poisoning.	
Symptoms	Fumes of hot asphalt can cause nausea and dizziness.	
Short Exposure Tolerance		
Exposure Procedures	If spilled onto skin, flood with water and get medical attention. Do not bind up, and do not try to scrub off adhering material.	

REACTIVITY DATA

Stability	Most grades are stable.
Compatibility	Because of the many grades, each should be considered separately.

BENZENE

Synonyms	: Benzol, Coal naphtha	Formula.....C ₆ H ₆
Appearance-Odor	: Colorless liquid; sweetish odor	Boiling Point.....80.1°C(176°F) Vapor Pressure.....75 mm Hg Vapor Density.....2.80 Freezing Point.....5.5°C(42°F)
Chemical Family	: Aromatic hydrocarbon	Solubility in Water..0.07% Specific Gravity.....0.88

POLLUTION HAZARD DATA

Aquatic Life	benzene concentrations as low as 5 mg/l and as high as 395 mg/l have been reported as toxic to fish.
Domestic Use	The taste threshold was found to be 0.5 mg/l of water. The odor threshold level is 0.8 to 54 mg/l of benzene in water. Oral LD ₅₀ is 5.6 g/kg of body weight for rats.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....A	
Flash Point.....-11.1°C(12°F)	
Flammable Limits, %.....1.4-7.1	
Autoignition Temp.....562°C(1044°F)	
Extinguishing Media.....CO ₂ , dry chemical, foam, water fog.	
Special Fire Procedures.....Fire parties must wear respiratory protection and rubber boots. In other respects, fight like a gasoline fire.	
General.....The vapors of benzene are more toxic than those of comparable petroleum products. In case of spill, secure ignition sources.	

HEALTH HAZARD DATA

Toxic Rating: 3

Odor Threshold (ppm): 100*

TLV (ppm): 25

Toxic Characteristics

Exposure to high concentrations irritates the respiratory tract, and may cause serious damage. The liquid is absorbed through the skin. The vapors are toxic, and dangerous to personnel.

Symptoms

Dizziness, headache, and drowsiness.

Short Exposure Tolerance

Vapor concentrations of 3,000 ppm are endurable for 30-60 minutes for a single exposure; 7,500 ppm are dangerous in 30-60 minutes for a single exposure; and 20,000 ppm have been fatal in 5-10 minutes.

Exposure Procedures

Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability

Stable under normal conditions.

Compatibility

Rubber on prolonged exposure to benzene first swells, then softens.

Remarks: *NOTE: Product may not be detected by smell although potentially dangerous vapor concentrations are present.

BUNKER "C"

Synonyms	: No 6 fuel oil	Formula.....
Appearance-Odor	: Very viscous, dark-colored, odoriferous liquid	Boiling Point.....>400°C(>750°F)
Chemical Family	: Hydrocarbon	Vapor Pressure.....
		Vapor Density.....
		Freezing Point.....
		Solubility in Water..
		Specific Gravity.....less than 1

POLLUTION HAZARD DATA

Aquatic Life	The effects vary with Bunker C composition species and environmental conditions. An approximate measure of toxicity may be estimated from the reported 48-hour TLm of about 2400 mg/l obtained for fish (Juvenile American Shad, <i>Alosa Sapidissima</i>). Free oil and emulsions may adhere to the gills of fish, or coat and destroy algae and other plankton. Soluble and emulsified material ingested by fish may taint the flavor of the flesh. Water-soluble components may exert toxic action on fish or fishfood organisms. Floating oil may reduce re-aeration at water surface and in conjunction with emulsified oil may interfere with photosynthesis.
Domestic Use	Taste and odor may be imparted to a drinking water source by soluble components, or the effectiveness of water treatment process may be decreased by emulsified oil. The TON (dilution ratio at which odor is just detectable) is reported to be 2,000,000.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Oil in boiler feed water may cause foaming, and decreased heat exchange resulting in overheating of tubes. Oil in water used for hydraulic transport may coat the product being conveyed. In many processing and production operations, the material may impart taste and odor to manufactured products. Processes which are affected include brewing, carbonated beverages, food canning and freezing, sugar production, and food equipment washing. Oil is also particularly objectionable in papermaking and textile manufacture.
General	The presence of oil in a water body is essentially restricted to the surface of the water and the shoreface. The oil will be degraded by physical, chemical and bacteriological actions, which on the shoreface will be en-

hanced by wave motion. Complete removal of the oil by these actions will normally require at least several weeks (probably several months), depending on the environmental factors such as temperature, nutrients, etc. As the lighter components are removed from oil, the residue that does not reach the shore may sink to the bottom.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to prevent taste and odor problems.
Agriculture	Temporarily shut off supply when large amount of emulsified oil is present.
Industry	Treat with activated carbon in those industries such as brewing, carbonated beverages, etc., which are affected by taste and odor. Temporarily shut off supply, or make required adjustment with existing water treatment equipment, when emulsified oil is present in sufficient quantity to interfere.
General	Control measures for oil spills include (1) use of booms for containment close to source and the protection of high value shore lines, (2) pumping and skimming devices, (3) collecting agents such as straw and plastic foam, (4) sinking agents consisting of powdered or fine granular solids of high density materials, and (5) the use of chemical agents such as detergents to disperse the material by emulsification. Due to the limited knowledge of the ecological effects of emulsifiers, the use of these materials should be restricted at the present time to relatively small oil spills and slicks and in situations where danger to life and property overrides considerations for water quality.

FIRE & EXPLOSION HAZARD DATA

Grade.....	C
Flash Point.....	66°C(150°F)
Flammable Limits, %.....	
Autoignition Temp.....	407°C(765°F)
Extinguishing Media.....	Foam, carbon dioxide, dry chemicals, or carbon tetrachloride
Special Fire Procedures....	
General.....	Heat must be added to sustain combustion.

HEALTH HAZARD DATA

Toxic Rating: unknown

Odor Threshold (ppm):

TLV (ppm):

Toxic Characteristics

Symptoms

Short Exposure Tolerance

Exposure Procedures

REACTIVITY DATA

Stability

Material is stable

Compatibility

Material is compatible with most materials of construction.

BUTANE

Synonyms	: Normal butane, n-butane	Formula..... C_4H_{10}
Appearance-Odor:	Colorless, odorless gas	Boiling Point..... $-0.5^{\circ}C(31.1^{\circ}F)$
Chemical Family:	Hydrocarbon	Vapor Pressure.....1520 mm Hg at 18.8 $^{\circ}C$
		Vapor Density.....3.07
		Freezing Point..... $-138.6^{\circ}C(-217^{\circ}F)$
		Solubility in Water.Negligible
		Specific Gravity....0.58

POLLUTION HAZARD DATA

Aquatic Life	No toxicological data are available. However, material should quickly dissipate from the water due to its insolubility, low boiling point and density.
Domestic Use	Because of above mentioned properties, material should not enter intake.
Agricultural Use	Same as above.
Industrial Uses	Same as above.

POLLUTION CONTROL MEASURES

Domestic Supply	No problem.
Agriculture	No problem.
Industry	No problem.

FIRE & EXPLOSION HAZARD DATA

Grade.....	Liquified Flammable Gas (LIG)
Flash Point.....	gas under normal conditions
Flammable Limits, %.....	1.9 - 8.5
Autoignition Temp.....	404 $^{\circ}C(761^{\circ}F)$
Extinguishing Media.....	Stop flow of gas, CO_2 , dry chemical, water fog.
Special Fire Procedures.....	Keep burning tank and tanks adjacent to it cool with a water spray.
General.....	Unless the flow of gas can be stopped, putting out a butane fire will permit the accumulation of an explosive concentration of vapor, and subsequent explosion or re-flash. Secure ignition sources.

HEALTH HAZARD DATA

Toxic Rating: 1	Odor Threshold (ppm): 5000	TLV (ppm):
Toxic Characteristics	Butane acts more like a simple asphyxiant, diluting the oxygen content to below that needed for survival.	
Symptoms	Dizziness and drowsiness.	
Short Exposure Tolerance	Drowsiness is caused by 10,000 ppm in 10 minutes.	
Exposure Procedures	Remove victim to fresh air; if breathing stops, apply artificial respiration. Get medical attention.	

REACTIVITY DATA

Stability	Stable product.
Compatibility	Non-corrosive to most materials of construction.

n-BUTYL ALCOHOL

Synonyms : Butanol

Appearance-Odor: Colorless liquid,
pungent alcoholic odor

Chemical Family: Alcohol

Formula..... $\text{CH}_3(\text{CH}_2)_3\text{OH}$

Boiling Point..... $118^\circ\text{C}(243^\circ\text{F})$

Vapor Pressure.....4.7 mm Hg

Vapor Density.....2.6

Freezing Point..... $-89.8^\circ\text{C}(-120^\circ\text{F})$

Solubility in Water..10%

Specific Gravity.....0.81

POLLUTION HAZARD DATA

Aquatic Life	An n-butyl alcohol concentration of 400 mg/l has killed fish in 51 minutes. Levels of 20-30 mg/l have been reported lethal to fish in 15 to 96 hrs.
Domestic Use	Oral LD ₅₀ for rats of 2.75 and 4.36 g/kg of body weight has been given. The odor threshold level is from 0.012 to 25 mg/l.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems depending on use.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below the taste and odor threshold level.
Agriculture	Hazard undetermined
Industry	Treat as described above where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....	B
Flash Point.....	$43^\circ\text{C}(110^\circ\text{F})$
Flammable Limits, %.....	1.4 - 11.2
Autoignition Temp.....	$343^\circ\text{C}(650^\circ\text{F})$
Extinguishing Media.....	dry chemical, CO ₂ , alcohol foam, water fog
Special Fire Procedures....	
General.....	Secure ignition sources in case of spill

HEALTH HAZARD DATA

Toxic Rating: 2	Odor Threshold (ppm): 25	TLV (ppm): 100
Toxic Characteristics	Causes minor skin irritation. Prolonged exposure will cause eye irritation.	
Symptoms	Headache, dizziness and respiratory irritation.	
Short Exposure Tolerance	May cause eye irritation with several hours exposure at 200 ppm.	
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.	

REACTIVITY DATA

Stability	Stable
Compatibility	

CARBON DISULFIDE

Synonyms	: Carbon bisulfide	Formula.....CS ₂
Appearance-Odor:	Colorless liquid, strong disagreeable odor	Boiling Point.....46°C(115°F)
Chemical Family:	Sulfide	Vapor Pressure.....297 mm Hg
		Vapor Density.....2.64
		Freezing Point.....-112°C(-167°F)
		Solubility in Water...0.22%
		Specific Gravity.....1.26

POLLUTION HAZARD DATA

Aquatic Life	Concentrations of carbon disulfide as low as 35 mg/l have been toxic to fish. A 7-minute exposure to 5,000 mg/l has caused trout to die in two days.
Domestic Use	Maximum permissible concentration of carbon disulfide in public water supplies has been set by USSR at 1 mg/l.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems depending on industrial use.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below 1 mg/l.
Agriculture	Hazard undetermined.
Industry	Treat as described above in industries where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....A	
Flash Point.....-30°C(-22°F) c.c.	
Flammable Limits, %.....1.3 - 4.4	
Autoignition Temp.....100°C(212°F)	
Extinguishing Media.....CO ₂ , dry chemical, water spray or fog	
Special Fire Procedures.....A	A self-contained breathing mask is recommended when burning carbon disulfide; produces sulfur dioxide, which is toxic (TLV of 5) and highly irritating.
General.....	Highly flammable liquid with low autoignition temperature; contact with steam line or hot, bare electric light bulb can cause ignition. Secure all ignition sources.

HEALTH HAZARD DATA

Toxic Rating: 3	Odor Threshold (ppm): 1.2	TLV (ppm): 20
Toxic Characteristics	Affects the nervous system. Inhalation causes narcosis and possible loss of consciousness; chronic exposure may result in permanent disability.	
Symptoms	Light-headedness, dizziness; prolonged contact with skin may cause burns.	
Short Exposure Tolerance	Severe symptoms and unconsciousness are caused by 1,100 ppm in $\frac{1}{2}$ hour; exposure to 4,815 ppm for 1 hour has been fatal.	
Exposure Procedures	Remove to fresh air. Give artificial respiration if unconscious. Get medical attention as soon as possible.	

REACTIVITY DATA

Stability	Under conditions encountered on tankships and barges, CS_2 is not dangerously reactive.
Compatibility	Slightly corrosive to metals due to impurities. Softens rubber and many plastics.

CARBON TETRACHLORIDE

Synonyms	: Tetrachloromethane	Formula..... CCl_4
Appearance-Odor:	Colorless liquid; sweetish odor	Boiling Point..... 77°C (168°F)
		Vapor Pressure.....100 mm Hg at 23°C
		Vapor Density.....5.49
Chemical Family:	Halocarbon	Freezing Point..... -22°C (-8°F)
		Solubility in Water...0.08%
		Specific Gravity.....1.59

POLLUTION HAZARD DATA

Aquatic Life	Insufficient information to establish hazard.
Domestic Use	Oral LD ₅₀ values of 7.5 and 12.8 g/kg of body weight have been reported for rats and mice, respectively. A maximum permissible concentration of 5 mg/l of CCl_4 in surface waters has been set by the Soviet Union, based on its organoleptic (taste and odor) properties.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems depending on use.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below 5 mg/l as well as taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above in industries where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....	Hazardous liquid
Flash Point.....	
Flammable Limits, %.....	
Autoignition Temp.....	
Extinguishing Media.....	
Special Fire Procedures.....	The liquid or vapor in contact with hot metal can decompose into phosgene, a highly toxic gas. Cool tanks near fire with water spray.
General.....	Does not burn

HEALTH HAZARD DATA

Toxic Rating: 4

Odor Threshold (ppm): 50*

TLV (ppm): 10

Toxic Characteristics

Readily absorbed through skin in toxic amounts. Vapors are toxic. Attacks liver and kidneys. May cause dermatitis. Persons having even a small amount of alcohol in their system are particularly susceptible.

Symptoms

Drowsiness followed by unconsciousness and by respiratory failure if exposure is prolonged.

Short Exposure Tolerance

Human fatalities have been reported after exposure to 1000-2000 ppm for 30-60 minutes.

Exposure Procedures

Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention. DO NOT give victim any preparation containing alcohol, because it could be fatal.

REACTIVITY DATA

Stability

Stable

Compatibility

Becomes corrosive when in contact with water.

Remarks: *NOTE: Odor threshold is not considered adequate warning of potentially dangerous vapor concentrations.

CAUSTIC POTASH SOLUTION

Synonyms	: Potassium hydroxide	Formula.....KOH
Appearance-Odor:	Colorless or light yellow syrupy liquid; odorless	Boiling Point.....varies
		Vapor Pressure.....varies
		Vapor Density.....varies
		Freezing Point.....varies
Chemical Family:	Alkali	Solubility in Water..complete
		Specific Gravity.....up to 1.54

POLLUTION HAZARD DATA

Aquatic Life	Upper pH limit tolerated by most freshwater fish is 8.4; algae are destroyed above 8.5. The potassium threshold concentration for fish in different kinds of water was found to be about 400 mg/l when potassium chloride, nitrate and sulfate was used. Potassium can be toxic to fish in soft waters at concentrations of 50-200 mg/l when present as the chloride and nitrate.
Domestic Use	A dose of 1-2 grams of potassium is cathartic, and 1,000 to 2,000 mg/l is regarded as the extreme limit of potassium permissible in drinking water. Taste threshold for potassium hydroxide and chloride are 1-50 and 340 mg/l, respectively. Increased pH can be deleterious to water treatment processes.
Agricultural Use	Excessive alkalinity in irrigation water can be detrimental to certain types of crops depending on the physical and chemical properties of the soil. High alkalinities in water can harm stock. When caustic alkalinity reaches 50 mg/l, chickens develop diarrhea, and at a total alkalinity of 170 mg/l, other animals are similarly affected.
Industrial Uses	Alkalinity can cause corrosion of aluminum, tin or lead parts or equipment, and is detrimental to certain processes, which are involved in the production of food and beverages. Recommended threshold values for total alkalinities in water supplies are: brewing 50-170 mg/l, carbonated beverages 50-170 mg/l, food products 30-250 mg/l, and pulp and paper making 45-150 mg/l. Foaming can be caused in boilers by more than 50 mg/l of potassium plus sodium in the water.

POLLUTION CONTROL MEASURES

Domestic Supply	Neutralize with sufficient acid (sulfuric or hydrochloric) to reduce concentration below taste threshold of potassium hydroxide. Temporarily shut off supply when concentration of material will result in over 250 mg/l of chloride or sulfate when neutralized.
Agriculture	Temporarily shut off supply or provide neutralization when high pH may be harmful to crop.
Industry	Neutralize with sufficient acid to prevent corrosion of aluminum, tin and lead parts, as well as in those industrial operations where excessive alkalinity may be detrimental. Temporarily shut off supply where excessive potassium may be harmful to operation.

FIRE & EXPLOSION HAZARD DATA

Grade.....	Corrosive liquid
Flash Point.....	
Flammable Limits, %.....	
Autoignition Temp.....	
Extinguishing Media.....	
Special Fire Procedures....	
General.....	Does not burn

HEALTH HAZARD DATA

Toxic Rating: 4	Odor Threshold (ppm):	TLV (ppm): 2 mg/m ³ *
Toxic Characteristics	Causes serious burns when in contact with skin. Contact with eyes causes serious injury.	
Symptoms	If solution splashes on skin no pain may be felt, but hair and skin touched by the liquid will begin to dissolve on contact.	
Short Exposure Tolerance		

Exposure Procedures

DO NOT DELAY! Flush affected part gently with plenty of water for at least 15 minutes. Remove contaminated shoes or clothing. Get medical attention.

REACTIVITY DATA

Stability

Stable

Compatibility

Aluminum is corroded rapidly. Animal products such as leather and wool are attacked to the extent that they dissolve.

* In the form of a fine spray or mist; value suggested by comparison with TLV of caustic soda.

CAUSTIC SODA SOLUTIONS

Synonyms	: Sodium hydroxide, lye	Formula.....NaOH
Appearance-Odor	: Colorless or gray	Boiling Point.....varies
syrupy liquid		Vapor Pressure.....varies
		Vapor Density.....varies
Chemical Family	: Alkali	Freezing Point.....varies
		Solubility in Water..complete
		Specific Gravity.....up to 1.53

POLLUTION HAZARD DATA

Aquatic Life	Upper pH limit tolerated by most freshwater fish is 8.4; Algae are destroyed above pH 8.5. Concentrations of 500-1000 mg/l of sodium have been found toxic to fish in salt waters, when present as the chloride or nitrate. In brackish waters, oyster larvae have been injured at pH 9 and found to die at pH 9.1 in a few hours. For crabs, the upper limit of pH has been found as 10.2.
Domestic Use	The taste threshold of sodium hydroxide in water is 1-50 mg/l. Sodium in drinking water may be harmful to persons suffering from cardiac, renal and circulatory diseases, and 200 mg of sodium in drinking water may be injurious.
Agricultural Use	Excessive alkalinity in irrigation water can be detrimental to certain crops and depending on the physical and chemical properties of the soil. High alkalinities in water can harm stock. When caustic alkalinity reaches 50 mg/l, chickens develop diarrhea and at total alkalinity of 170 mg/l, other animals are similarly affected.
Industrial Uses	Alkalinity can cause corrosion of aluminum, tin or lead parts or equipment and is detrimental to certain processes, such as those involved in the production of food and beverages. The range of recommended threshold values for total alkalinities in water supplies are: brewing 50-170 mg/l, carbonated beverages 50-170 mg/l, food products 30-250 mg/l, and pulp and paper making 45-150 mg/l. Foaming may be caused in boilers by more than 50 mg/l of potassium plus sodium in the water.

POLLUTION CONTROL MEASURES

Domestic Supply	Neutralize with sufficient acid (sulfuric or hydrochloric) to reduce concentrations below taste threshold of sodium hydroxide (1-50 mg/l).
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	Temporarily shut off supply when neutralization would result in a sulfate or chloride level above 250 mg/l.
Agriculture	Temporarily shut off supply or provide neutralization when excess alkalinity may be harmful to crop.
Industry	Neutralize with sufficient acid to prevent corrosion of aluminum, tin or lead parts as well as in those industrial operations where alkalinity is detrimental such as the production of carbonated and acid fruit beverages.
	Temporarily shut off supply in industries where excessive salt concentration may be harmful to operation.

FIRE & EXPLOSION HAZARD DATA

Grade.....	Corrosive liquid
Flash Point.....	
Flammable Limits, %.....	
Autoignition Temp.....	
Extinguishing Media.....	
Special Fire Procedures....	
General.....	Does not burn

HEALTH HAZARD DATA

Toxic Rating: 4	Odor Threshold (ppm):	TLV: 2 mg/m ³ *
Toxic Characteristics	Causes serious burns when in contact with skin. Contact with eyes causes serious injury.	
Symptoms	If the solution splashes onto skin no pain may be felt, but hair and skin touched by caustic will begin to dissolve on contact.	
Short Exposure Tolerance		
Exposure Procedures	Do not delay! Flush affected areas gently with plenty of water for at least 15 minutes. Remove contaminated shoes or clothing. Get medical attention.	

REACTIVITY DATA

Stability	Stable
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Compatibility

Aluminum is attacked vigorously. Animal products such as leather and wool are attacked to the extent that they dissolve.

* in the form of a fine mist or spray.

CHLORINE

Synonyms :	Formula.....Cl ₂
Appearance-Odor: Brown liquid or greenish yellow gas; choking odor	Boiling Point.....-35°C(-29°F)
	Vapor Pressure.....4800 mm Hg
	Vapor Density.....2.4
Chemical Family:	Freezing Point.....-101.6°C(-149.1°F)
	Solubility in Water..1% at 10°C(60°F)
	Specific Gravity.....1.4

POLLUTION HAZARD DATA

Aquatic Life	Free available chlorine may be toxic to fish and other aquatic life at low concentrations; lethality increased with decreasing pH values. Concentrations of 0.03 mg/l free chlorine have been reported toxic or harmful to fish. Most algae have been controlled by 0.25 to 3.0 mg/l, and killed at 5 to 10 mg/l. Minute crustacea, rotifers, and diatoms have been killed by 1.0 mg/l, but worms, mullusks, mites and larvae were not affected.
Domestic Use	Chlorine in drinking water may cause asthma, colitis, and eczema, but generally concentrations of up to 90 mg/l have been used by humans without adverse effect. Chlorine concentrations of 2.0 mg/l have not been found to cause objectionable tastes and odors. Reaction with certain organic materials, such as phenols and benzenes, produces compounds which affect the taste and odor of water at lower levels than chlorine or the parent organic compounds.
Agricultural Use	No injury to plants occurred when irrigation water contained 50 mg/l or less residual chlorine; concentrations of 100 to 150 mg/l injured or retarded some plants and did not affect others; 200 to 300 mg/l injured tops but did not harm roots of plants and 500 to 1000 mg/l retarded growth of seedlings and killed tops and roots of plants.
Industrial Uses	Chlorine may cause taste and odor problems in food and canning industries as well as cause the corrosion of cans. In metal plating baths, chlorine may affect brightness and smoothness of deposits. T.A.P.P.I. recommends a limit of 2 mg/l in the manufacture of fine papers.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to re-
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duce concentration below taste and odor threshold level (granular carbon has long been used for removing residual chlorine from water).

Agriculture

Generally no problem up to 50 mg/l of residual chlorine. Above this concentration, shut off supply when level of material is above concentration that will affect particular crop.

Industry

Treat as described above in certain industries, such as brewing, soft drinks, fine papers and electroplating, where material will adversely affect product or processing.

FIRE & EXPLOSION HAZARD DATA

Grade.....Nonflammable compressed poisonous gas
Flash Point.....
Flammable Limits, %.....
Autoignition Temp.....
Extinguishing Media.....
Special Fire Procedures....Chlorine tanks exposed to fire should be cooled with a water spray to decrease the buildup of pressure.
General.....Chlorine is non-explosive and non-flammable. However, it can support combustion of certain substances.

HEALTH HAZARD DATA

Toxic Rating: 4 Odor Threshold (ppm): 3-5* TLV (ppm): 1

Toxic Characteristics Skin irritant; it causes severe eye injury. The gas is a respiratory irritant; persons with chronic respiratory ailments are particularly susceptible to severe discomfort.

Symptoms Vapor - coughing, choking, burning sensation in eyes and throat, and shortness of breath. Liquid - severe irritation or blistering. Frostbite can also result.

Short Exposure Tolerance Exposure to a vapor concentration of 1000 ppm for 10 minutes has caused death.

Exposure Procedures Remove victim to fresh air. If breathing stops, apply artificial respiration. Oxygen, administered by trained personnel, is often helpful. If eyes are

affected, wash gently with water for 15 minutes. If liquid chlorine has spilled onto the skin, remove contaminated clothing and flood the exposed area gently with water for 15 minutes. Get medical attention.

General

In case of accidental release, evacuate all downwind personnel not equipped with gas masks.

REACTIVITY DATA

Stability

Will react with many inorganic and organic compounds, usually with the evolution of heat.

Compatibility

Dry chlorine does not corrode steel. When wet, chlorine is highly corrosive as a result of the formation of acids. Avoid contact with both spilled liquid and the gas it gives off.

Remarks: * NOTE! Odor threshold is higher than the TLV. Exposure to potentially dangerous vapor concentrations can occur before the product can be detected by smell.

Coast Guard Regulations require a warning sign to be displayed by barges carrying this commodity. The following is an example of acceptable wording:

DANGER! CHLORINE

NONFLAMMABLE COMPRESSED GAS

TOXIC - NO VISITORS

CHLOROFORM

Synonyms	: Trichloromethane	Formula.....CHCl ₃
Appearance-Odor:	Colorless liquid; sweet odor	Boiling Point.....61.2°C(142°F)
		Vapor Pressure.....159.6 mm Hg
		Vapor Density.....4.25
Chemical Family:	Halocarbon	Freezing Point.....-63.5°C(-82°F)
		Solubility in Water..0.76%
		Specific Gravity.....1.48

POLLUTION HAZARD DATA

Aquatic Life	At a concentration of 10 mg/l of chloroform, fish struggle for 20-30 minutes and then sink to the bottom. They revived when placed in fresh water.
Domestic Use	Oral LD ₅₀ values are 2.2 g/kg of body weight for rats, and 10 g/kg for rabbits.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems depending on use.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below 20 mg/l and the taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....	
Flash Point.....	
Flammable Limits, %.....	
Autoignition Temp.....	
Extinguishing Media.....	
Special Fire Procedures....	When heated or exposed to a naked flame, chloroform decomposes to form phosgene, a poison gas. In case of fire tanks containing chloroform should be kept cool with a water spray.
General.....	Does not burn.

HEALTH HAZARD DATA

Toxic Rating: 4	Odor Threshold (ppm): *	TLV (ppm): 50
Toxic Characteristics	Contact with skin can cause burns. It is a narcotic and an anaesthetic. It has a harmful cumulative effect on the liver.	
Symptoms	Irritation of mucous membranes and skin; drowsiness.	
Short Exposure Tolerance	Inhalation of 400 to 600 ppm for 30 minutes or less can prove fatal.**	
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.	

REACTIVITY DATA

Stability	Decomposes in the presence of excess water or at high temperature to give phosgene and hydrogen chloride, which are very toxic. Can become explosive in the presence of strong alkalies and water.
Compatability	Non-corrosive at normal atmospheric temperatures when free of moisture. In contact with water and at high temperatures it becomes corrosive.

* NOTE: Odor threshold is higher than the TLV. Exposure to potentially dangerous vapor concentrations can occur before the product can be detected by smell.

**Encyclopedia of Chemical Technology - Kirk-Othmer Second Edition, Volume 5.

CRESOL

Synonyms	: Cresylic acid	Formula..... $\text{CH}_3\text{C}_6\text{H}_4\text{OH}$
Appearance-Odor:	Colorless-to-brown liquid; smells like "Lysol" disinfectant	Boiling Point..... $191-203^\circ\text{C}$ ($378-395^\circ\text{F}$)
Chemical Family:	Phenol	Vapor Pressure..... $1.7-3.55$ mm Hg @ 60°C
		Vapor Density.....3.72
		Freezing Point..... $18-35^\circ\text{C}$ ($54-95^\circ\text{F}$)
		Solubility in Water...2%
		Specific Gravity.....1.03 - 1.05

POLLUTION HAZARD DATA

Aquatic Life	A concentration of cresol of 5 mg/l has been found to be toxic to fish.
Domestic Use	The 1962 Public Health Service Drinking Water Standards recommend a limit of 0.001 mg/l for "phenols" (understood to include cresols). The limit has been set on the basis of taste and odor in chlorinated waters. Unchlorinated cresols have an odor threshold level of 0.02 - 4 mg/l in water. Oral LD_{50} for rats has been given as 1.35 - 2.0 g/kg of body weight for the isomers.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problem depending on use.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient activated or powdered carbon to reduce cresol concentration to 0.001 mg/l or below (basis for limit is undesirable taste often resulting from chlorination).
Agriculture	Hazard undetermined.
Industry	Treat with sufficient activated or powdered carbon in industries, such as food and beverage, where material will cause a taste, odor or other problem.

FIRE & EXPLOSION HAZARD DATA

Grade.....	B or C
Flash Point.....	$43-82^\circ\text{C}$ ($110-180^\circ\text{F}$); varies with composition and purity.
Flammable Limits, %.....	LEL 1.1; UEL not available

Autoignition Temp.....560-650°C(1038-1195°F)
Extinguishing Media.....CO₂, dry chemical, foam, water fog
Special Fire Procedures....Cresol corrodes the skin and the fumes are poisonous.
Full body and respiratory protection should be
provided.
General.....When heated, toxic vapors are given off.

HEALTH HAZARD DATA

Toxic Rating: 3	Odor Threshold (ppm): 5*	TLV (ppm): 5
Toxic Characteristics	Cresol causes flesh burns. It is readily absorbed through the skin, causing systemic poisoning. The vapors are irritating to the eyes and respiratory tissue. When handled at elevated temperatures, greater amounts of vapor are given off and the toxic hazard is increased.	
Symptoms	Burning sensation in throat, nose and eyes. Burning sensation at the site of contact; skin may turn white.	
Short Exposure Tolerance		
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected area with water for 15 minutes. Get medical advice or attention.	

REACTIVITY DATA

Stability	Not dangerously reactive.
Compatibility	Not considered corrosive to most of the usual materials of construction.

*NOTE: Odor threshold is about the same as the TLV. Exposure to potentially dangerous vapor concentration can occur before the product can be detected by smell.

CRUDE OIL

Synonyms	: petroleum, crude petroleum, earth oil, seneca oil	Formula.....Mixture of paraffinic, naphthenic, and aromatic hydrocarbons and minor amounts of nitrogenous, sulfur, oxygenated, and trace metals.
Appearance-Odor	: Varies in color from black, amber, red, brown to fluorescent green; odor varies from asphaltic to that of H ₂ S.	Boiling Point.....varies Vapor Pressure.....varies Vapor Density.....varies Freezing Point.....varies Solubility in Water...negligible Specific Gravity.....0.68 - 1.0
Chemical Family	: Hydrocarbon	

POLLUTION HAZARD DATA

Aquatic Life	Oil and emulsions may adhere to the gills of fish, or coat and destroy algae and other plankton. Soluble and emulsified material ingested by fish may taint the flavor of the flesh. Water-soluble components may exert a toxic action on fish or fishfood organisms. Floating oil may reduce reaeration at water surface and in conjunction with emulsified oil may interfere with photosynthesis.
Domestic Use	Taste and odor may be imparted to a drinking water source by soluble components, or the effectiveness of water treatment process may be decreased by emulsified oil.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Oil in boiler feed water may cause foaming and decreased heat exchange causing overheating of tubes. Oil in water used for hydraulic transport may coat the product being conveyed. In many processing and production operations, the material may impart taste and odor to manufactured products. Industrial operations where this may occur include brewing, carbonated beverages, food canning and freezing, sugar production, and food equipment washing. Oil interferes in the manufacture of paper and textiles.
General	The majority of oil in a water body is usually found on the surface of the water and the shoreface. The oil will be degraded by physical, chemical and bacteriological actions, which will be enhanced on the shoreface by wave motion. Complete removal of the oil by these actions will normally require several weeks to several months, depending on environmental factors such as temperature, nutrients, etc.

As the lighter components are removed from oil, some of the residue that does not reach the shore may sink to the bottom.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to prevent taste and odor problems.
Agriculture	Temporarily shut off supply when large amount of emulsified oil is present.
Industry	Treat with activated carbon in those industries such as brewing, carbonated beverages, etc., which are affected by taste and odor. Temporarily shut off supply, or make required adjustment with existing water treatment equipment, when emulsified oil interferes with industrial operation.
General	Control measures for oil spills include (1) use of booms for containment close to source and the protection of high value shore lines, (2) pumping and skimming devices, (3) collecting agents such as straw and plastic foam, (4) sinking agents consisting of powdered or fine granular solids of high density materials, and (5) the use of chemical agents such as detergents to disperse the material by emulsification. Due to the very limited knowledge regarding the ecological effects of emulsifiers, the use of these materials should be restricted at the present time to relatively small oil spills and slicks and in situations where water quality will not be significantly affected or where danger to life and property overrides considerations for water quality. Due to the changing character of crude oil by weathering, the most effective treatment and recovery is accomplished within the first few hours following a spill.

FIRE & EXPLOSION HAZARD DATA

Grade.....	A or B depending on composition.
Flash Point.....	varies with composition
Flammable Limits, %.....	varies with composition
Autoignition Temp.....	varies with composition
Extinguishing Media.....	CO ₂ , dry chemical, carbon tetrachloride, foam
Special Fire Procedures.....	Tanks exposed to fire should be kept cool with water spray.

General.....The lower molecular weight hydrocarbons are the most flammable, and are therefore related to the degree of combustibility of a particular oil.

HEALTH HAZARD DATA

Toxic Rating: 2 Odor Threshold (ppm): varies TLV (ppm): varies

Toxic Characteristics

Symptoms Dizziness, drowsiness

Short Exposure Tolerance

Exposure Procedures

REACTIVITY DATA

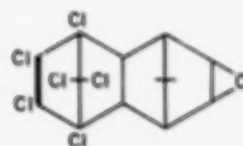
Stability May emit toxic fumes when heated to decomposition.

Compatibility Natural rubber is softened and will deteriorate rapidly. May react with oxidizing agents.

DIELDRIN

Synonyms : 1,2,3,4,10,10-hexachloro-6, 7-ep γ -1,4,4a,5,6,7,8, 8a-octahydro-1,4-endoexo-5,8-dime-
thanonaphthalene, compound 497, HEOD

Formula.....



Appearance-Odor: Pure compound is white, odor-free and crystalline. The 85% product, which is marketed as dieldrin, is a brown flaky material having a musty odor.

Chemical Family: Chlorinated hydrocarbon

Boiling Point.....n.a.
Vapor Pressure..... 1.8×10^{-7}
Vapor Density.....13.2
Freezing Point..... 176°C (348.8°F)
Solubility in Water...0.1 mg/l
Bulk Density.....0.8 g/ml

POLLUTION HAZARD DATA

Aquatic Life	Dieldrin gave 96-hour TLM values ranging from 0.0056 to 0.042 mg/l, depending on the formulation, species of fish, and water hardness.
Domestic Use	Acute oral LD ₅₀ values of dieldrin for rats range from 37 to 87 mg/kg of body weight. Differences in dieldrin toxicities are ascribed to the grade of dieldrin employed and to the nature of its formulation. The estimated fatal dose of dieldrin for a man of 70 kg is 5 grams. In several cases of dieldrin intoxication, contamination of water even with small quantities was found to be very dangerous.
Agricultural Use	Dieldrin is used as an insecticide. The application of dieldrin at 3 lbs/acre caused most losses in wildlife during the week following application. Ground squirrels, muskrats, and rabbits were virtually eliminated, short-tailed shrews, fox squirrels, woodchucks, and meadow mice sustained heavy losses.
Industrial Uses	Substance may cause taste, odor or other problems.
General	<u>DO NOT</u> flush into body of water.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration to below 0.1 mg/l. Special care should be used in operation of coagulation and filtering system
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to assure effective removal of turbidity and colloidal matter (dieldrin will be associated with these suspended solids).

Agriculture

No known problem.

Industry

Treat as described above to reduce below tolerable level in those industries which may be adversely affected such as the food and beverage.

FIRE & EXPLOSION HAZARD DATA

Grade.....C
 Flash Point.....depends on solvent composition
 Flammable Limits, %.....depends on solvent composition
 Autoignition Temp.....unknown
 Extinguishing Media.....CO₂, dry chemical, foam, water fog
 Special Fire Procedures.....Highly toxic HCl fumes emitted on heating
 General.....Although dieldrin is nonflammable, many of its liquid emulsible concentrate formulations using organic solvents burn.

HEALTH HAZARD DATA

Toxic Rating: 2

Odor Threshold (ppm):

TLV: 0.25 mg/m³

Toxic Characteristics

Dieldrin is absorbed through skin and other portals. It acts as nervous system stimulant. It greatly reduces or stops appetite. Initial symptoms are nervousness or anorexia. Appetite may recur occasionally in extremely sick animals.

Symptoms

Loss of appetite, headache, nausea, vomiting, general malaise, and dizziness. With more severe poisoning, clonic and tonic convulsions ensue without premonitory symptoms just mentioned. Hyperexcitability and hyperirritability are common.

Short Exposure Tolerance

unknown

Exposure Procedures

If spilled on skin, remove by thorough washing with soapwater emulsion. Remove from alimentary canal by the use of lavage and/or saline laxatives. Do not use oily laxatives.

REACTIVITY DATA

Stability

Material is stable

Compatibility

Compatible with most materials, except strong bases or acids.

DIESEL OIL

Synonyms	: Fuel oil No. 2, gas	Formula.....
oil		Boiling Point.....232-430°C (450-800°F)
Appearance	Odor: Brown, slightly	Vapor Pressure.....varies
	viscous liquid; smells like kerosene	Vapor Density.....varies
Chemical Family:	Hydrocarbon	Freezing Point.....varies
		Solubility in Water..slight
		Specific Gravity.....0.8 - 0.9

POLLUTION HAZARD DATA

Aquatic Life	The effects of diesel oil on aquatic life, which vary with species and environmental conditions, have not been precisely determined. An approximate measure of toxicity of diesel oil may be estimated from the reported 24-hour TLM of about 200 mg/l for fish (Juvenile American Shad, <u>Alosa Sapidissima</u>). Soluble and emulsified material ingested by fish taints the flavor of the flesh. Water-soluble components may exert a toxic action on fish or fishfood organisms. Floating oil on water may reduce reaeration at water surface and along with emulsified oil may interfere with photosynthesis.
Domestic Use	Taste and odor may be imparted to drinking water by the soluble components, or effectiveness of water treatment may be decreased by emulsified oil. For deodorized kerosene, a related product, a threshold odor concentration of 0.082 mg/l and an oral LD ₅₀ for rabbits of 28.35 g/kg of body weight has been reported.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Oil in boiler feed water may cause foaming, and decreased heat exchange causing overheating of tubes. Oil in water used for hydraulic transport may coat the product being conveyed. In many process and production operations, the material may impart taste and odor to manufactured products. Certain operations such as brewing, carbonated beverages, food canning and freezing, sugar production, and food equipment washing may be affected. Oil interferes with the manufacture of paper and textiles.
General	Most of the spill is usually found on the surface of the water. The oil will generally dissipate in a few hours to several days, mostly by spreading and evaporation, depend-

ing on the amount spilled, water movement, temperature and other factors.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to prevent taste and odor problems. Temporarily shut off supply if quantity of emulsified oil interferes with water treatment.
Agriculture	Temporarily shut off supply when large amount of emulsified oil is present.
Industry	Treat with activated carbon in those industries such as brewing, carbonated beverages, etc., which are affected by taste and odor. Temporarily shut off supply, or make required adjustment with existing water treatment equipment, when emulsified oil is present in sufficient quantity to interfere with industrial operation.
General	Diesel fuel, due to its elevated flash point, will generally not constitute a fire hazard. Control measures for spills include (1) use of booms for containment close to source and the protection of high value shore lines, (2) pumping and skimming devices, (3) collecting agents such as straw and plastic foam, (4) sinking agents consisting of powdered or fine granular solids of high density materials, and (5) the use of chemical agents such as detergents to disperse the material by emulsification. Due to limited knowledge regarding the ecological effects of emulsifiers, the use of these materials should be restricted at the present time to relatively small oil spills and slicks and to situations where water quality will not be significantly affected or where danger to life and property overrides considerations for water quality. As the nature of the residual oil changes with weathering, the most effective recovery and treatment is accomplished within the first few hours following the spill.

FIRE & EXPLOSION HAZARD DATA

Grade.....B
Flash Point.....43-88°C(110-190°F)
Flammable Limits, %.....
Autoignition Temp.....257°C(494°F)
Extinguishing Media.....CO₂, dry chemical, foam, water fog.
Special Fire Procedures....Do not direct water directly into fire.
General.....Flash point and other physical characteristics depend upon composition of oil.

HEALTH HAZARD DATA

Toxic Rating: 1	Odor Threshold (ppm):	TLV (ppm):
Toxic Characteristics	Inhalation of high concentration of vapor can cause headache and stupor. Ingestion causes irritation of stomach and intestines with nausea and vomiting.	
Symptoms	See toxic characteristics.	
Short Exposure Tolerance		
Exposure Procedures		

REACTIVITY DATA

Stability	Material is stable
Compatibility	Does not react with most materials of construction or with common chemicals.

ETHYL ALCOHOL

Synonyms	: Ethanol	Formula.....C ₂ H ₅ OH
Appearance-Odor:	Colorless liquid; smells like wine or shellac thinner	Boiling Point.....78°C(173°F)
Chemical Family:	Alcohol	Vapor Pressure.....42.3 mm Hg
		Vapor Density.....1.6
		Freezing Point.....-114.5°C(-178°F)
		Solubility in Water..Complete
		Specific Gravity.....0.79

POLLUTION HAZARD DATA

Aquatic Life	Fish and other aquatic life withstand high concentrations of ethyl alcohol but, like humans, fish become intoxicated. Sticklebacks in tap water containing 40,000 mg/l became intoxicated. The lethal range for gudgeon, a European fresh water fish is 7,000 - 9,000 mg/l.
Domestic Use	The oral LD ₅₀ is 7.4 g/kg of body weight for rats.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below 50 mg/l and the taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....	A
Flash Point.....	21°C(70°F)
Flammable Limits, %.....	4.3-19
Autoignition Temp.....	423°C(793°F)
Extinguishing Media.....	CO ₂ , dry chemical, alcohol foam, water fog.
Special Fire Procedures....	Water may not be effective unless large quantities are used.
General.....	In case of spill, secure ignition sources.

HEALTH HAZARD DATA

Toxic Rating: 1

Odor Threshold (ppm): 350

TLV (ppm): 1000

Toxic Characteristics

Usually made unfit for drinking by the addition of denaturants which may be foul-smelling or tasting.

Symptoms

Dizziness, double vision, and other classic alcohol intoxication symptoms. These may be accompanied by symptoms such as vomiting, attributable to the denaturant.

Short Exposure Tolerance

Eyes and upper respiratory tract are irritated by 5000-10,000 ppm. Stupor and drowsiness may result after an hour at this concentration. Headache and eye irritation are caused by 1000 ppm.

Exposure Procedures

Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Eye contact - gently flush with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability

Stable

Compatibility

Compatible with most materials of construction.

ETHYLENE DIAMINE

Synonyms	: 1,2-Diaminoethane; 1,2-Ethanediamine	Formula..... $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$
Appearance-Odor	: Colorless liquid; mildly ammonia-like odor	Boiling Point.... 117.2°C (242.6°F)
Chemical Family	: Amine	Vapor Pressure...10.7 mm Hg
		Vapor Density....2.1
		Freezing Point... 8.5°C (47.3°F)
		Solubility in Water..Complete
		Specific Gravity.....0.91

POLLUTION HAZARD DATA

Aquatic Life	Fish of average tolerance exposed for 24 hours in well aerated water have all survived at 30 mg/l, but all died at 60 mg/l.
Domestic Use	Oral LD_{50} for rats is 1.16 g/kg of body weight.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below 10 mg/l and the taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....	B
Flash Point.....	43°C (110°F)
Flammable Limits, %.....	not available
Autoignition Temp.....	
Extinguishing Media.....	CO_2 , dry chemical, alcohol foam, water fog.
Special Fire Procedures....	Because this material can cause severe eye and skin burns and respiratory distress, fire parties must wear full body and respiratory protection.

HEALTH HAZARD DATA

Toxic Rating: 2	Odor Threshold (ppm):	TLV (ppm): 10
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Toxic Characteristics	The primary effects of acute inhalation exposure are irritation of the respiratory passages and the eyes. Liquid contact can cause immediate skin damage and blistering.
Symptoms	Coughing, redness of eyes, wheezing breath.
Short Exposure Tolerance	Immediate and severe irritation to nose and throat has been caused by 400 ppm.
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Oxygen, administered by trained personnel, can prove helpful. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.
General	On-scene supervisors should avoid exposing to the vapors persons who have asthma or other respiratory ailments.

REACTIVITY DATA

Stability	Reacts with oxidizing materials.
Compatibility	Copper and its alloys are corroded readily and should be avoided.

2-ETHYL HEXANOL

Synonyms	: 2-ethylhexyl alcohol, octyl alcohol	Formula..... $C_4H_9CH(C_2H_5)CH_2OH$
		Boiling Point..... $182^{\circ}C(359^{\circ}F)$
Appearance-Odor:	Colorless liquid	Vapor Pressure.....0.2 mm Hg
		Vapor Density.....4.5
Chemical Family:	Alcohol	Freezing Point..... $-76^{\circ}C(-105^{\circ}F)$
		Solubility in Water.....0.1%
		Specific Gravity.....0.83

POLLUTION HAZARD DATA

Aquatic Life	Of the 23 octyl alcohols, of which 2-ethyl hexanol is one of the most common, the least toxic produced paralysis in goldfish in four hours at 200 mg/l. No effect was noted when sea lamprey were exposed for 24-hour in Lake Huron to 5 mg/l at $12^{\circ}C$.
Domestic Use	Oral LD50 for rats is 3.2 g/kg of body weight. The octyl alcohols are colorless liquids, generally with a penetrating aromatic odor.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered and activated carbon to reduce concentration below 30 mg/l and the taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....	C
Flash Point.....	$85^{\circ}C(185^{\circ}F)$
Flammable Limits, %.....	not available
Autoignition Temp.....	
Extinguishing Media.....	CO_2 , dry chemical, alcohol foam, water fog
Special Fire Procedures.....	

HEALTH HAZARD DATA

Toxic Rating: 2

Odor Threshold (ppm):

TLV (ppm):

Toxic Characteristics

Symptoms

Short Exposure Tolerance

Exposure Procedures

Little data available. A spill onto skin or eyes should be washed off immediately with water. Medical attention should be sought if any skin rash develops, if liquid splashed into the eyes, or if a person exposed to the vapor shows signs of respiratory difficulty.

REACTIVITY DATA

Stability

Stable compound.

Compatibility

FORMALDEHYDE SOLUTIONS

Synonyms : Formalin, methylene oxide	Formula.....HCHO
Appearance-Odor : Colorless liquid; pungent, irritating odor	Boiling Point.....97°C(206°F) for 37% solution.
Chemical Family : Aldehyde	Vapor Pressure.....1.3 mm Hg for 37% solution.
	Vapor Density.....Approx. 1.03
	Freezing Point.....varies
	Solubility in Water..Complete
	Specific Gravity.....1.11 - 1.13

POLLUTION HAZARD DATA

Aquatic Life	Concentrations of 25 mg/l of formaldehyde have been harmful to fish and between 130 and 175 mg/l are toxic to aerobic organisms.
Domestic Use	Oral LD ₅₀ for rats is 800 mg/kg of body weight. The odor threshold level is 0.8 to 102 mg/l in water.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems.

POLLUTION CONTROL MEASURES.

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below 10 mg/l and the taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above where material will present a taste, odor or other problem.

FIRE & EXPLOSION HAZARD DATA

Grade.....	B or C liquid depending upon concentration.
Flash Point.....	50-85°C(122-185°F)
Flammable Limits, %.....	7.0 - 73 (formaldehyde vapor in air)
Autoignition Temp.....	430°C(806°F)
Extinguishing Media.....	CO ₂ , dry chemical, alcohol foam, water fog
Special Fire Procedures....	The vapors are highly irritating, so fire parties should wear respiratory protection. Secure ignition sources in case of spill.
General.....	When the solution is heated, highly flammable vapors are given off.

HEALTH HAZARD DATA

Toxic Rating: 3	Odor Threshold (ppm): below 1 TLV (ppm): 5
Toxic Characteristics	The vapors are highly irritating to the eyes and respiratory passages. Contact with liquid causes hardening of the skin.
Symptoms	Coughing, copious watering of the eyes, severe respiratory irritation.
Short Exposure Tolerance	At a vapor concentration of 10 to 20 ppm breathing becomes difficult. Exposure to 650 ppm for a few minutes may cause death.
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability	Solutions are often shipped at elevated temperatures to prevent polymer formation.
Compatibility	Corrosive to steel and to copper and its alloys. The commercial material is shipped as water solution of from about 37% to 50% concentration. Methanol is often used to inhibit polymerization.

FURFURAL

Synonyms : Furfuraldehyde,
furfurol

Appearance-Odor: Colorless-to-
reddish-brown liquid; penetrating
almond-like odor

Chemical Family: Aldehyde

Formula..... C_4H_3OCHO
Boiling Point..... $161^{\circ}C(322^{\circ}F)$
Vapor Pressure.....1 mm Hg at $18.5^{\circ}C$
Vapor Density.....3.31
Freezing Point..... $-37^{\circ}C(-34^{\circ}F)$
Solubility in Water.8.3%
Specific Gravity....1.16

POLLUTION HAZARD DATA

Aquatic Life	A 24-hour TLM of 32 mg/l has been reported for bluegill sunfish.
Domestic Use	Oral LD ₅₀ value for dogs is 2.3 g/kg of body weight. Concentrations of 10,000 to 50,000 mg/l was found to be lethal in 114 to 548 days in the drinking water of albino rats. The odor threshold is 4 mg/l, when a musty odor is evident.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....C
Flash Point..... $68^{\circ}C(155^{\circ}F)$
Flammable Limits, %.....LEL 2.1; UEL not available
Autoignition Temp..... $395^{\circ}C(743^{\circ}F)$
Extinguishing Media.....CO₂, dry chemical, alcohol foam, water fog.
Special Fire Procedures....When heated, the liquid gives off vapor which is
poisonous.

HEALTH HAZARD DATA

Toxic Rating: 3	Odor Threshold (ppm): 0.4	TLV (ppm): 5
Toxic Characteristics	Ordinarily there is little danger from vapors because of the low vapor pressure. The liquid is irritating to the eyes, and the vapor to the mucous membranes.	
Symptoms	Irritation of respiratory passages.	
Short Exposure Tolerance		
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention:	

REACTIVITY DATA

Stability	Furfural can explode on contact with strong mineral acids and alkalis. Reacts with numerous organic materials.
Compatibility	Dissolves or softens many plastics and rubber formulations.

GASOLINE

Synonyms	: Petrol	Formula.....Mixture of aliphatic, naphthenic and aromatic hydrocarbons
Appearance-Odor:	Clear, aromatic, volatile liquid	Boiling Point.....0-200°C(32-392°F)
Chemical Family:	Hydrocarbon	Vapor Pressure.....varies
		Vapor Density.....3.0 - 4.0
		Freezing Point.....varies
		Solubility in Water..varies
		Specific Gravity.....less than 1

POLLUTION HAZARD DATA

Aquatic Life	The effects of gasoline on aquatic life, which vary with species and environmental conditions, have not been precisely determined. An approximate measure of the toxicity of gasoline may be estimated from the reported 24-hour TLM of about 90 mg/l for fish (Juvenile American Shad, <u>Alosa Sapidissima</u>). Soluble and emulsified material ingested by fish may taint the flavor of the flesh. Water soluble components may exert a direct toxic action on fish or fishfood organisms.
Domestic Use	Taste and odor may be imparted to drinking water source by soluble components, or effectiveness of water treatment process may be decreased by emulsified oil. Some persons can detect gasoline in water at a TON (dilution ratio at which odor is just detectable) of 1,100,000, most people notice it at 500,000, and it is quite evident at 100,000.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	In many processing and production operations, oily substances may impart taste and odor to manufactured products. Industrial operations where this may occur include brewing, carbonated beverages, food canning and freezing, sugar production, and food equipment washing.
General	The presence of oil in a water body is essentially restricted to the surface of the water. Due to its volatility, a gasoline spill will normally dissipate within a few hours to a day, depending on amount, environmental factors such as temperature, nutrients, etc. Gasoline due to its low flash point constitutes an extreme fire hazard which should be considered when treating spills near shore installations and ships.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to prevent taste and odor problem. Temporarily shut off supply if quantity of emulsified oil interferes with water treatment.
Agriculture	Temporarily shut off supply when large amount of emulsified oil is present.
Industry	Treat with activated carbon in those industries such as brewing, carbonated beverages, etc., which are affected by taste and odor. Temporarily shut off supply, or make required adjustment with existing water treatment equipment, when emulsified oil is present in sufficient quantity to interfere with industrial operation.

FIRE & EXPLOSION HAZARD DATA

Grade.....A
Flash Point.....-46°C(-50°F)
Flammable Limits, %.....1.3 - 6.0
Autoignition Temp.....257°C(495°F)
Extinguishing Media.....Foam, CO₂, dry chemical
Special Fire Procedures....

HEALTH HAZARD DATA

Toxic Rating: 2	Odor Threshold (ppm):	TLV (ppm): 500
Toxic Characteristics	Vapors are not considered very poisonous, unless its vapor concentration is high enough to reduce the oxygen content causing asphyxiation.	
Symptoms	Can cause hyperemia of the conjunctiva and other disturbances of the eye.	
Short Exposure Tolerance		
Exposure Procedures		

REACTIVITY DATA

Stability	Material is stable
Compatibility	Will soften rubber and certain plastics

GLYCERINE

Synonyms	: Glycerol, 1,2,3 propanetriol	Formula..... $\text{CHOH}(\text{CH}_2\text{OH})_2$
Appearance-Odor:	Colorless liquid; faint, pleasant odor	Boiling Point..... $290^\circ\text{C}(554^\circ\text{F})$
Chemical Family:	alcohol	Vapor Pressure..... $0.0025 \text{ mm Hg at } 50^\circ\text{C}$
		Vapor Density.....3.17
		Freezing Point..... $18^\circ\text{C}(64^\circ\text{F})^*$
		Solubility in Water...Complete
		Specific Gravity.....0.94

POLLUTION HAZARD DATA

Aquatic Life	In natural waters, glycerol appears to exert no inimical effect other than an oxygen demand arising from decomposition. Tench have survived 16 hours in tap water (8°C) containing 100,000 mg/l of glycerol without apparent harm.
Domestic Use	Oral LD_{50} is 8-32 g/kg of body weight for rats, mice and guinea pigs.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as above where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....	C
Flash Point.....	$177^\circ\text{C}(350^\circ\text{F})$
Flammable Limits, %.....	not available
Autoignition Temp.....	$392^\circ\text{C}(739^\circ\text{F})$
Extinguishing Media.....	CO_2 , dry chemical, alcohol foam, water fog
Special Fire Procedures....	

* Small amounts of water or other impurities will lower the freezing point.

HEALTH HAZARD DATA

Toxic Rating: 1

Odor Threshold (ppm):

TLV (ppm): Not
established

Toxic Characteristics

Symptoms

Liquid can cause skin irritation.

Short Exposure Tolerance

Exposure Procedures

Wash glycerine from skin with water. Launder clothing contaminated by the liquid.

REACTIVITY DATA

Stability

Reacts with strong oxidizing agents. Polymerizes above 150°C(300°F)

Compatibility

HYDROCHLORIC ACID

Synonyms	: Muriatic acid	Formula.....HCl (dissolved in water)
Appearance-Odor:	Colorless liquid; sharp, sour odor	Boiling Point.....110°C (230°F)
Chemical Family:	Acid	Vapor Pressure.....212 mm Hg *
		Vapor Density.....1.26
		Freezing Point.....
		Solubility in Water...complete
		Specific Gravity.....1.01 - 1.21 *

POLLUTION HAZARD DATA

Aquatic Life	Lower tolerable limit for most fish is pH 5 and for the most resistant species pH value of 4 is given. At a pH below 5, specialized flora and fauna may develop.
Domestic Use	Excessive acidity may result in corrosion, as well as affect taste, efficiency of chlorination, and treatment processes such as coagulation. Water acquires a "sour" taste at pH 3.9 or below, except in highly buffered solutions. HCl can be tasted at concentrations of about 32 mg/l in water, although this threshold is dependent upon the buffering power of the water. USPHS Drinking Water Standards (1962) recommend that chlorides do not exceed 250 mg/l.
Agricultural Use	Low pH can be detrimental to crops depending on the nature of the soil. At concentrations below 100 mg/l, chloride is not generally harmful in irrigation water. Levels in excess of 4,000 mg/l can cause injury to livestock.
Industrial Uses	Low pH will cause corrosion and chlorides can exert a significant effect on the rate of corrosion of steel and aluminum. Recommended threshold concentrations for chlorides are: brewing 60-100 mg/l, carbonated beverages 250 mg/l, dairy industry 30 mg/l, papermaking 75-200 mg/l, steel manufacturing 175 mg/l, sugar making 20 mg/l, and textile processes 100 mg/l.

POLLUTION CONTROL MEASURES

Domestic Supply	Neutralize with lime or other available alkali to prevent taste, corrosion or interference with water treatment.
	Temporarily shut down supply when chloride concentrations exceed 250 mg/l.

* Values change with concentration.

Agriculture	Neutralize with alkali or shut down supply when low pH may cause corrosion of distribution system or is harmful to crop.
Industry	Neutralize with alkali or temporarily shut down supply when low pH may cause corrosion of distribution system and equipment. Temporarily shut down supply in industries such as brewing, carbonated beverages, dairy, food, paper, steel manufacturing, sugar making and textile, when excessive chloride concentrations may adversely affect operation.

FIRE & EXPLOSION HAZARD DATA

Grade.....	Nonflammable
Flash Point.....	
Flammable Limits, %.....	
Autoignition Temp.....	
Extinguishing Media.....	
Special Fire Procedures....	Acid tanks exposed to a fire should be cooled by a water spray. Fire parties must wear respiratory protection in order to avoid breathing acid vapor.
General.....	Hydrochloric acid will not burn. It will react with many metals, giving off hydrogen gas which is highly flammable. If hydrogen is trapped in confined spaces it can form an explosive mixture with air. See data sheet for hydrogen.

HEALTH HAZARD DATA

Toxic Rating: 4	Odor Threshold (ppm): 1-5	TLV (ppm): 5
Toxic Characteristics	Highly corrosive to skin. The vapor will irritate the eyes and respiratory system.	
Symptoms	Where touched by liquid, the skin may tingle or burn. Breathing the vapors will cause severe coughing and watering of the eyes.	
Short Exposure Tolerance		
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Oxygen, administered by trained personnel, is often helpful. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15	

minutes. Get medical attention or advice.

REACTIVITY DATA

Stability	Reacts with bases to generate heat.
Compatibility	Corrodes many metals, causing the evolution of hydrogen gas. Iron and aluminum are corroded readily.

Remarks: Coast Guard Regulations require a warning sign to be displayed by barges carrying this commodity. The following is an example of acceptable wording:

DANGER! HYDROCHLORIC ACID

CORROSIVE LIQUID

TOXIC - NO VISITORS

NO SMOKING OR OPEN LIGHTS

HYDROFLUORIC ACID

Synonyms	: Aqueous Hydrogen fluoride	Formula.....HF
Appearance	Odor: Colorless liquid; pungent irritating odor	Boiling Point.....49-110°C(120-230°F)
Chemical Family:	Acid	Vapor Pressure.....varies
		Vapor Density.....varies
		Freezing Point.....varies
		Solubility in Water..complete
		Specific Gravity.....1.12-1.26

POLLUTION HAZARD DATA

Aquatic Life	Lower tolerable limit for most fish is pH-5. The most resistant species may survive at pH 4. At a pH below 5, specialized flora and fauna may develop. Hydrogen fluoride, per se, is harmful to fish at 40 mg/l and lethal at 60 mg/l.
Domestic Use	USPHS Drinking Water Standards for 1962 set a mandatory limit on fluorides ranging from 0.6 to 1.5 mg/l in drinking water (mottled teeth) depending on the annual average maximum daily air temperatures. Fluorides in doses of 250 to 450 mg give severe symptoms and 4 grams cause death in humans.
Agricultural Use	Fluoride concentrations of 10 mg/l caused no injury to peach, tomato, and buckwheat plants. Peach and buckwheat plants were severely injured by fluoride concentration of 100 mg/l in 3 days. Fluoride concentration of 1,000 mg/l stunted growth of large bean plants.
Industrial Uses	Excess acidity causes corrosion. Excess fluorides may be harmful to certain industries, such as those manufacturing the food, beverages, pharmaceutical and medical items.

POLLUTION CONTROL MEASURES

Domestic Supply	Temporarily shut down supply when fluoride concentration is above 1 mg/l.
Agriculture	Neutralize with alkali or shut down supply when low pH may cause corrosion or harm crops. Temporarily shut down supply when concentration of fluoride is above 10 mg/l for peach, tomato or buck-wheat crops (information not available for other crops).

Industry

Neutralize with alkali or shut down supply when pH is low to prevent corrosion.

Temporarily shut down supply when fluoride is detrimental. Recommended threshold value for brewing, carbonated beverages and food processing is 1 mg/l.

FIRE & EXPLOSION HAZARD DATA

Grade.....Non flammable

Flash Point.....

Flammable Limits, %.....

Autoignition Temp.....

Extinguishing Media.....

Special Fire Procedures....Tanks exposed to a fire should be cooled by a water spray. Fire parties must wear respiratory protection in order to avoid breathing acid vapors.

General.....Hydrofluoric acid will not burn. It will react with many metals, giving off hydrogen gas which is highly flammable. If hydrogen is trapped in a confined space it can form an explosive mixture with air. See data sheet for hydrogen.

HEALTH HAZARD DATA

Toxic Rating: 4

Odor Threshold (ppm):

TLV (ppm): 3

Toxic Characteristics

In contact with any part of the body it causes serious burns. Extremely dangerous to eyes, lungs, and mucous tissue.

Symptoms

Severe burning, choking sensation in throat and nasal passages. Skin contact may not be felt at once.

Short Exposure Tolerance

Vapor concentrations above 50 ppm are dangerous for short exposures.

Exposure Procedures

Remove victim to fresh air. If he has inhaled the vapor, do not permit him to get up or exert himself in any way until checked by a physician. Oxygen, administered by trained personnel, may be helpful. Wash spilled liquid from skin with water while removing contaminated clothing, or from eyes by flooding gently with water for at least 15 minutes. All inhalation or contact cases should be seen by a physician.

REACTIVITY DATA

Stability	Highly reactive with many substances.
Compatibility	Corrodes many metals, causing the evolution of hydrogen gas. Lead, rubber and a limited number of plastics are often used for lining tanks. Reacts with glass containers.

HYDROGEN (Liquified)

Synonyms	: LH_2	Formula..... H_2
Appearance-Odor:	Colorless liquid; odorless	Boiling Point..... $-252.7^\circ\text{C}(-423^\circ\text{F})$
Chemical Family:		Vapor Pressure.....
		Vapor Density.....0.07
		Freezing Point..... $-259.1^\circ\text{C}(-434.6^\circ\text{F})$
		Solubility in Water..Negligible
		Specific Gravity at b.p. 0.07

POLLUTION HAZARD DATA

Aquatic Life	Material should quickly dissipate from water due to its low solubility, boiling point and density.
Domestic Use	Material should not enter intake because of the above mentioned properties.
Agricultural Use	Material should not enter intake because of the above mentioned properties.
Industrial Uses	Material should not enter intake because of the above mentioned properties.

POLLUTION CONTROL MEASURES

Domestic Supply	Treatment not generally required.
Agriculture	Treatment not generally required.
Industry	Treatment not generally required.

FIRE & EXPLOSION HAZARD DATA

Grade.....	LIG (Liquefied flammable gas)
Flash Point.....	
Flammable Limits, %.....	4.0 - 75
Autoignition Temp.....	$580^\circ\text{C} (1075^\circ\text{F})$
Extinguishing Media.....	Shut off hydrogen source; CO_2 , dry chemical, water
Special Fire Procedures.....	Source of hydrogen MUST be eliminated before fire is put out to prevent accumulation of explosive vapors. If the insulation fails on a liquid hydrogen tank exposed to fire, the tank will explode; evacuate firefighters and have them take cover.

General.....Will react violently with strong oxidizers. Will ignite easily with oxygen. Vapors form explosive or combustible mixtures with air over a wide range of concentrations.

HEALTH HAZARD DATA

Toxic Rating: 1	Odor Threshold (ppm)	TLV:(ppm):
Toxic Characteristics	Skin contact with liquid hydrogen will cause severe frostbite. The vapor acts as an asphyxiant.	
Symptoms	Inhalation: drowsiness and high-pitched, squeaky voice. Skin contact: numbness and whitening of skin at the area of contact.	
Short Exposure Tolerance		
Exposure Procedures	Remove victim to fresh air; if breathing stops, apply artificial respiration. In case of skin contact with liquid or cold gas, thaw frosted parts with cold water. DO NOT RUB. Get medical attention immediately. Avoid sparks and open flames.	

REACTIVITY DATA

Stability	Will ignite readily when exposed to spark source. Liquid hydrogen will flash into vapor at temperatures above -400°F resulting in a sudden and large increase in pressure if confined.
Compatibility	Mild steel and most iron alloys become brittle at liquid hydrogen temperatures. Aluminum and stainless steel (300 series) may be used.

Remarks: Coast Guard Regulations require a warning sign to be displayed by barges carrying this commodity. The following is an example of acceptable wording:

DANGER: LIQUID HYDROGEN

LIQUEFIED FLAMMABLE GAS

NO VISITORS, SMOKING OR OPEN LIGHTS

HYDROGEN CHLORIDE

Synonyms	: Hydrochloric acid, anhydrous	Formula.....HCl
Appearance-Odor:	Colorless gas or liquid; sharp, biting odor	Boiling Point.....-85°C(-121°F)
Chemical Family:	Acid anhydride	Vapor Pressure.....632 mm Hg
		Vapor Density.....1.3
		Freezing Point.....-112°C(-169°F)
		Solubility in Water...67%
		Specific Gravity.....

POLLUTION HAZARD DATA

Aquatic Life	See hydrochloric acid.
Domestic Use	See hydrochloric acid.
Agricultural Use	See hydrochloric acid.
Industrial Uses	See hydrochloric acid.

POLLUTION CONTROL MEASURES

Domestic Supply	See hydrochloric acid.
Agriculture	See hydrochloric acid.
Industry	See hydrochloric acid.

FIRE & EXPLOSION HAZARD DATA

Grade.....	Non flammable
Flash Point.....	
Flammable Limits, %.....	
Autoignition Temp.....	
Extinguishing Media.....	
Special Fire Procedures.....	A tank exposed to fire should be cooled by a water spray.
General.....	When wet HCl forms hydrochloric acid. Although the acid does not burn, it will react with many metals, giving off hydrogen gas which is highly flammable. If hydrogen is trapped in confined spaces it can form an explosive mixture with air. See data sheet for hydrogen.

HEALTH HAZARD DATA

Toxic Ratings	4	Odor Threshold (ppm): 1-5	TLV (ppm): 5
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Toxic Characteristics	Corrosive to skin and irritating to eyes and respiratory system.
Symptoms	Severe eye and respiratory irritation. If liquid is sprayed onto the skin it will boil off rapidly and produce severe frostbite.
Short Exposure Tolerance	
Exposure Procedures	Remove victim to fresh air. Give artificial respiration if unconscious. Oxygen administered by trained personnel, is often helpful. Frostbitten areas should be handled gently. Get medical attention.
General	When release occurs, clear away personnel without respiratory protection and protective clothing. Water fog will help to remove the gas from the atmosphere.

REACTIVITY DATA

Stability	Hydrogen chloride is stable when dry. When wet it forms hydrochloric acid, which is quite reactive.
Compatibility	Hydrogen chloride is not corrosive to steel when dry, but highly corrosive when wet.

KEROSINE

Synonyms	: Fuel oil No. 1, coal oil, range oil	Formula.....mixture of petroleum hydrocarbons, mostly aliphatic containing from 10 to 16 carbon atoms
Appearance-Odor:	pale yellow to water-white oily liquid	Boiling Point.....175-345°C (293-653°F)
Chemical Family:	Hydrocarbon	Vapor Pressure.....varies Vapor Density.....4.5 Freezing Point.....varies Solubility in Water..negligible Specific Gravity.....0.8 - 0.9

POLLUTION HAZARD DATA

Aquatic Life	The approximate toxicity of kerosine may be estimated from the value reported for diesel, which had a 24-hour TLM of about 200 mg/l with fish (Juvenile American Shad, <i>Alosa Sapidissima</i>). Ingestion by fish may taint the flavor of the flesh. Water-soluble components may exert a direct toxic action on fish or fishfood organisms.
Domestic Use	Taste and odor may be imparted to a drinking water source, or effectiveness of water treatment may be decreased. A threshold odor concentration of 0.082 mg/l has been reported for deodorized kerosine. An oral LD ₅₀ of kerosine for rabbits has been given as 28.35 g/kg of body weight. The values are expected to change with composition.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Oil in boiler feed water may cause foaming, and decreased heat exchange causing overheating of tubes. Kerosine may impart taste and odor to manufactured products. Industrial operations where this may occur include brewing, carbonated beverages, food canning and freezing, sugar production, and food equipment washing. Oil interferes with the manufacture of paper and textiles.
General	The presence of kerosine in a water body is essentially restricted to the surface of the water. Complete removal of the oil, mostly by evaporation normally requires several hours to a day, depending on the quantity and environmental factors such as temperature, wind, nutrients, etc.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to prevent taste and odor problem. Temporarily shut off supply if quantity of oil interferes with water treatment.
Agriculture	Temporarily shut off supply when large amount of oil is present.
Industry	Treat with activated carbon in those industries such as brewing, carbonated beverages, etc., which are affected by taste and odor. Temporarily shut off supply, or make required adjustment with existing water treatment equipment, when oil is present in sufficient quantity to interfere.
General	Control measures for kerosine spills include (1) use of booms for containment close to source and the protection of high value shore lines, (2) pumping and skimming devices, (3) the use of chemical agents such as detergents to disperse the material by emulsification. Due to limited knowledge regarding the ecological effects of emulsifiers, the latter should be restricted to relatively small oil spills and slicks and to situations where water quality will not be significantly affected or where danger to life and property overrides considerations for water quality.

FIRE & EXPLOSION HAZARD DATA

Grade.....	B
Flash Point.....	38-74°C (100-165°F)
Flammable Limits, %.....	1.2-6.0
Autoignition Temp.....	254°C (490°F)
Extinguishing Media.....	foam, carbon dioxide, dry chemical, carbon tetrachloride
Special Fire Procedures....	
General.....	Moderate fire hazard

HEALTH HAZARD DATA

Toxic Rating: 1

Odor Threshold (ppm):

TLV (ppm):

Toxic Characteristics

Symptoms

High concentrations of vapor cause headache and stupor. Ingestion causes irritation of stomach and intestines with nausea and vomiting.

Short Exposure Tolerance

Exposure Procedures

REACTIVITY DATA

Stability

Compatibility

METHYL CHLORIDE

Synonyms	: Chloromethane	Formula.....CH ₃ Cl
Appearance-Odor:	Colorless gas or liquid, faintly sweet odor	Boiling Point.....-24°C(-11°F)
		Vapor Pressure.....3800 mm Hg
		Vapor Density.....1.78
Chemical Family:	Halocarbon	Freezing Point.....-97°C(-142°F)
		Solubility in Water..0.5%
		Specific Gravity.....0.92

POLLUTION HAZARD DATA

Aquatic Life	Insufficient information to establish hazard.
Domestic Use	Water saturated with methyl chloride at 20°C is sharp, sickening and sweetish when first taken into the mouth, followed immediately by a burning sensation. Ingestion of water containing almost 6,000 mg/l of methyl chloride caused no apparent symptom of poisoning or changes in the hemoglobin or blood cells of dogs.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems depending on industrial use.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below 10 mg/l and the taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....	
Flash Point.....	
Flammable Limits, %.....	8.1 - 17.2
Autoignition Temp.....	632°C(1170°F)
Extinguishing Media.....	Stop flow of gas; CO ₂ dry chemical, water fog
Special Fire Procedures....	Keep tank cool with water spray. Both the vapor of the product and of its combustion products are poisonous. Provide firefighters with respiratory protection. In case of release, secure ignition sources.

General.....Extinguishing the fire without stopping the gas leakage may increase the danger by permitting the accumulation of an explosive mixture.

HEALTH HAZARD DATA

Toxic Rating: 3	Odor Threshold (ppm): *	TLV (ppm): 100
Toxic Characteristics	Hazard is high for both acute and chronic exposures. Death may result from a single high exposure or repeated moderate exposures.	
Symptoms	Dizziness, staggering gait, drowsiness; recovery is slow. Frostbitten areas will be white.	
Short Exposure Tolerance	Dizziness is produced in 20 minutes by 800-1000 ppm.	
Exposure Procedures	Remove victim to fresh air. Apply artificial respiration if breathing stops. If the liquid has spilled onto the person, points of contact may be frostbitten. Protect any frozen areas from mechanical damage. Get medical attention.	

REACTIVITY DATA

Stability	Decomposes upon contact with moisture. At high temperatures it may decompose to phosgene, chlorine and carbon monoxide.
Compatibility	When in contact with aluminum, the product which forms may ignite spontaneously in air. Do not use aluminum, aluminum alloys, zinc, die castings, magnesium or magnesium alloys.

Remarks: *NOTE: Detectable odor is higher than TLV. Exposure to potentially dangerous vapor concentrations can occur before the product can be smelled.

Coast Guard Regulations require a warning sign to be displayed by barges carrying this commodity. The following is an example of acceptable wording:

DANGER!. METHYL CHLORIDE

FLAMMABLE COMPRESSED GAS

TOXIC - NO VISITORS

NO SMOKING OR OPEN LIGHTS

METHYL ETHYL KETONE

Synonyms	: 2-Butanone, MEK	Formula..... $\text{CH}_3\text{COC}_2\text{H}_5$
Appearance-Odor:	Colorless liquid; pleasant odor-smells like lacquer thinner	Boiling Point..... 79.6°C (176°F)
Chemical Family:	Ketone	Vapor Pressure.....100 mm Hg at 25°C
		Vapor Density.....2.48
		Freezing Point..... -86.9°C (-123°F)
		Solubility in Water...37%
		Specific Gravity... .780

POLLUTION HAZARD DATA

Aquatic Life	A 24-hour TLm value of 5,600 mg/l has been obtained for blue-gill sunfish in tap water and mosquito fish in highly turbid water. The sunfish were visibly affected by 3,400 mg/l.
Domestic Use	Oral LD ₅₀ is 4 g/kg of body weight for rats.
Agricultural Use	Insufficient information to establish hazard.
Industrial Use	Substance may cause taste, odor or other problems.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentrations below 40 mg/l and the taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....	A
Flash Point.....	-1°C (30°F)
Flammable Limits, %.....	1.8-10
Autoignition Temp.....	515°C (960°F)
Extinguishing Media.....	CO_2 , dry chemical, alcohol foam, water fog
Special Fire Procedures....	
General.....	In case of spill, secure ignition sources.

HEALTH HAZARD DATA

Toxic Rating: 2	Odor Threshold (ppm): below 25 TLV (ppm): 200
Toxic Characteristics	Causes narcotic symptoms, and skin irritations.
Symptoms	Dizziness, headache, nausea, and lack of coordination.
Short Exposure Tolerance	
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.

REACTIVITY DATA

Stability	Stable
Compatibility	Will soften and dissolve many plastics.

NAPHTHALENE

Synonyms :	Formula..... $C_{10}H_8$
Appearance-Odor: Colorless liquid or white solid; odor of mothballs	Boiling Point..... $218^{\circ}C(424^{\circ}F)$
	Vapor Pressure.....1 mm Hg at $52.6^{\circ}C$
	Vapor Density.....4.42
Chemical Family: Aromatic hydrocarbon	Freezing Point..... $80.2^{\circ}C(176^{\circ}F)$
	Solubility in Water..30 ppm
	Specific Gravity.....1.145

POLLUTION HAZARD DATA

Aquatic Life	Concentrations of 5 mg/l have killed sunfish in one hour. An exposure to 17 mg/l for one hour did not kill minnows but caused them to stop eating. The killing strength for perch has been given as 20 and 40 mg/l. The critical level for fingerling silver salmon in aerated seawater for a 72-hour exposure was found to be between 1.8 and 3.2 mg/l. A concentration of 1.0 mg/l affected the taste of the flesh of bleak.
Domestic Use	The probable lethal oral dose of naphthalene for a man is 5-15 g. A dose of 2 g given over a period of 2 days killed a 6-year old child.
Agricultural Use	Insufficient information to establish hazard.
Industrial Use	Substance may cause taste, odor or other problems.
General	Upon spilling, the materials will solidify and can be shoveled into a waste container. Naphthalene spilling into water will either solidify and sink or solidify into a foam and float.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient activated or powdered carbon to reduce concentration below the taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as above in industries where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....C
Flash Point..... $88^{\circ}C(190^{\circ}F)$

Flammable Limits, %.....0.9 - 5.9
 Autoignition Temp.....558°C(1038°F)
 Extinguishing Media.....CO₂, dry chemical, foam, water fog
 Special Fire Procedures....Do not direct a hose into a tank of naphthalene unless the temperature is below 212°F. Otherwise the naphthalene will be spattered about with explosive force. Water or foam must be applied carefully to molten naphthalene to prevent excessive frothing.
 General.....Combustible Grade C solid which, because of its low melting point, is often carried in the molten state. When carried molten, it presents a fire hazard comparable to that of a Grade B flammable liquid.

HEALTH HAZARD DATA

Toxic Rating: 1	Odor Threshold (ppm): 25*	TLV (ppm): 25
Toxic Characteristics	Vapors cause irritation to skin; prolonged exposure can cause injury to eyes and systemic poisoning to respiratory system.	
Symptoms		
Short Exposure Tolerance		
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.	

REACTIVITY DATA

Stability	Stable
Compatibility	Most materials of construction are satisfactory.

Remarks: Normally transported at elevated temperatures.

*NOTE: Exposure to potentially dangerous vapor concentration can occur before the product is detected by smell.

NITROGEN TETRAOXIDE

Synonyms	: NTO, nitrogen peroxide, nitrogen dioxide	Formula..... N_2O_4 (or NO_2)
Appearance-Odor:	Reddish-brown liquid, irritating acid-like odor	Boiling Point..... $21.3^\circ C (70^\circ F)$
Chemical Family:	Acid anhydride	Vapor Pressure..... $760+ \text{ mm Hg}$
		Vapor Density.....3.2
		Freezing Point..... $-11^\circ C (12^\circ F)$
		Solubility in Water..decomposes
		Specific Gravity.....1.45

POLLUTION HAZARD DATA

Aquatic Life	N_2O_4 reacts with water to form HNO_3 . See nitric acid.
Domestic Use	See nitric acid
Agricultural Use	See nitric acid
Industrial Uses	See nitric acid

POLLUTION CONTROL MEASURES

Domestic Supply	See nitric acid
Agriculture	See nitric acid
Industry	See nitric acid

FIRE & EXPLOSION HAZARD DATA

Grade.....	
Flash Point.....	
Flammable Limits, %.....	
Autoignition Temp.....	
Extinguishing Media.....	Water spray or fog
Special Fire Procedures.....	Remove or shut off source of nitrogen tetroxide. The vapors are extremely toxic; respiratory equipment is required. Protective clothing required. Do not use carbon tetrachloride extinguisher. Tanks exposed to fire should be cooled by a water spray.
General.....	Does not burn, but under certain conditions it will support combustion. It may form explosive mixtures with combustible materials.

HEALTH HAZARD DATA

Toxic Rating: 4	Odor Threshold (ppm): 5*	TLV (ppm): 5
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Toxic Characteristics	Class A poison! Liquid can cause severe burns to skin and eyes.
Symptoms	Irritation of eyes and throat, coughing, tightness of chest, and nausea. Severe symptoms may be delayed several hours.
Short Exposure Tolerance	Eyes, nose and throat are irritated by 10-20 ppm.
Exposure Procedures	Liquid - immediately flush skin or eyes gently with water. Remove contaminated clothing. Get medical attention. Continue to flush affected areas until doctor arrives. Vapor - remove victim to fresh air. All exposures to vapor MUST receive medical attention.
General	Evacuate personnel not equipped with protective clothing and respiratory equipment. Flush area with large quantities of water. Protective clothing should be worn during all handling operations.

REACTIVITY DATA

Stability	Highly reactive oxidizing agent which will react readily with organic materials.
Compatibility	Although not corrosive to common structural metals when dry, NTO is highly corrosive when wet. Copper and its alloys are attacked severely by NTO whether wet or dry.

*NOTE: The odor of NTO IS NOT sufficient to give adequate warning against exposure to dangerous vapor concentrations.

OLEUM

Synonyms	: Fuming sulfuric acid	Formula..... $\text{H}_2\text{SO}_4 \cdot \text{SO}_3$
Appearance-Odor:	Colorless, oily liquid; sharp, penetrating odor	Boiling Point..... $135-77^\circ\text{C}$ (275 to 170°F)
Chemical Family:	Acid anhydride	Vapor Pressure.....0 to 190 mm Hg
		Vapor Density.....2.76
		Freezing Point.....*
		Solubility in Water.Complete
		Specific Gravity....1.88 to 1.98

POLLUTION HAZARD DATA

Aquatic Life	See sulfuric acid. Much heat is generated by spill into open water which may kill fish in the vicinity of the spill. No toxic hazard on dilution below 1%.
Domestic Use	See sulfuric acid.
Agricultural Use	See sulfuric acid.
Industrial Uses	See sulfuric acid.

POLLUTION CONTROL MEASURES

Domestic Supply	See sulfuric acid.
Agriculture	See sulfuric acid.
Industry	See sulfuric acid.

FIRE & EXPLOSION HAZARD DATA

Grade.....	None assigned
Flash Point.....	
Flammable Limits, %.....	
Autoignition Temp.....	
Extinguishing Media.....	
Special Fire Procedures....	DO NOT USE WATER to put out a fire if the water can get into oleum. In case of a fire next to an oleum tank, wear respiratory protection against fumes.
General.....	Oleum will not burn. It will react with many metals, giving off hydrogen gas which is highly flammable. If hydrogen is trapped in confined spaces it can form an explosive mixture with air. See data sheet for hydrogen.

*The freezing point for 20% SO_3 is about -4°C (25°F). It rises with SO_3 concentration to about 35°C (95°F) at 45%, then falls off to about -1°C (30°F) at 66%.

HEALTH HAZARD DATA

Toxic Rating: 4	Odor Threshold (ppm):	TLV (ppm): 1 mg/m ³ *
Toxic Characteristics	Extremely dangerous to eyes, skin, respiratory tract, etc.	
Symptoms	Severe respiratory irritation. Skin burns will result from contact with the liquid.	
Short Exposure Tolerance		
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected area with water for 15 minutes. Get medical attention as soon as possible.	

REACTIVITY DATA

Stability	Reacts violently with water, producing a great deal of heat.
Compatibility	

Remarks: *The TLV is given for acid as a mist or spray.

Coast Guard Regulations require a warning sign to be displayed by barges carrying this commodity. The following is an example of acceptable wording:

DANGER! OLEUM

CORROSIVE LIQUID

TOXIC - NO VISITORS

NO SMOKING OR OPEN LIGHTS

OXYGEN DIFLUORIDE

Synonyms	: Fluorine monoxide	Formula.....OF ₂
Appearance-Odor:	Yellow-brown liquid or colorless gas	Boiling Point.....-145°C(-229°F)
		Vapor Pressure.....
Chemical Family:		Vapor Density.....1.9
		Freezing Point.....-224°C(-371°F)
		Solubility in Water...reacts
		Specific Gravity.....(liq.) 1.90

POLLUTION HAZARD DATA

Aquatic Life	Insufficient information to establish hazard.
Domestic Use	Insufficient information to establish hazard.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Insufficient information to establish hazard.

POLLUTION CONTROL MEASURES

Domestic Supply	Temporarily shut off supply when fluoride concentration is above 1 mg/l.
Agriculture	If sufficient acidity should develop, provide neutralization where low pH may cause corrosion or harm crops.
	Temporarily shut off supply when concentration of fluoride is above 10 mg/l for peach, tomato or buckwheat crops (information not available for others).
Industry	If low pH develops, provide sufficient neutralization to prevent corrosion. Temporarily shut off supply when fluoride level is detrimental to industrial use (recommended threshold value for brewing, carbonated beverages and food processing is 1 mg/l).

FIRE & EXPLOSION HAZARD DATA

Grade.....	Nonflammable gas
Flash Point.....	
Flammable Limits, %.....	
Autoignition Temp.....	
Extinguishing Media.....	Use media suitable for material which is burning.
Special Fire Procedures....	Provide respiratory protection. If a fire breaks out near an OF ₂ tank and the tank insulation fails, the tank will explode. Evacuate fire fighters to a safe distance and have them take cover.

General.....Will not burn, but supports combustion vigorously.

HEALTH HAZARD DATA

Toxic Rating: 4*	Odor Threshold (ppm):	TLV (ppm): 0.05*
Toxic Characteristics	Toxicity data are limited. There may be delayed effects. Contact with liquid will cause severe frostbite and should be avoided.	
Symptoms	Choking, coughing	
Short Exposure Tolerance		
Exposure Procedures	Remove victim to fresh air. Give artificial respiration if breathing stops. Oxygen administered by trained personnel may be helpful. Keep him still. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. DO NOT RUB frostbitten areas. Persons exposed to this material should be placed under medical observation for several days because of possible delayed effects.	
General	In case of spill, evacuate and rope off contaminated area. Keep unprotected personnel upwind.	

REACTIVITY DATA

Stability	Stable at room temperature, but decomposes to oxygen and fluorine at higher temperatures. OF ₂ will flash into vapor at -58°C (-72°F) with attendant volume and/or pressure increase. It reacts slowly with water.
Compatibility	OF ₂ is a strong oxidizing agent and should be kept away from combustible materials.

*tentative

PHENOL

Synonyms	: Carbolic acid, mono-hydroxybenzene	Formula..... C_6H_5OH
		Boiling Point..... $182^{\circ}C(360^{\circ}F)$
		Vapor Pressure..... $0.35\text{ mm Hg at }25^{\circ}C$
Appearance-Odor:	Colorless-to-pink solid; sweet, disinfectant-like odor (like Lysol)	Vapor Density.....3.24
		Freezing Point..... $40^{\circ}C(106^{\circ}F)$
		Solubility in Water.8.2%
Chemical Family:	Phenol	Specific Gravity....1.05

POLLUTION HAZARD DATA

Aquatic Life	The 24-, 48- and 96-hour TLM concentrations for fish are 1 to 20 mg/l at $20^{\circ}C$. The threshold concentration for fish is about 1 mg/l. Phenols are less toxic toward fish-food organisms and other lower aquatic life than to fish. Taste may be imparted to the flesh of fish.
Domestic Use	USPHS Drinking Water Standards (1962) limit the concentration of phenolic compounds to 0.001 mg/l, because of tastes resulting from the action of chlorine on such waters. It is not likely that harmful concentrations of phenol will be consumed in drinking water because such concentrations are much higher than the taste threshold.
Agricultural Use	No known deleterious effects have been noted on crops irrigated with phenol-containing water.
Industrial Uses	Phenol is deleterious in the food and beverage industries.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient activated or powdered carbon to reduce phenol concentration to 0.001 or below (basis for limit is undesirable taste often resulting from chlorination).
Agriculture	Not considered to be deleterious to crops.
Industrial	Treat with sufficient activated or powdered carbon in industries such as food and beverage which are adversely affected.

FIRE & EXPLOSION HAZARD DATA

Grade.....C
Flash Point.....85°C(185°F)
Flammable Limits, %.....
Autoignition Temp.....715°C(1319°F)
Extinguishing Media.....CO₂, dry chemical, foam, water fog
Special Fire Procedures....When there is a danger of skin contact, provide full body protection. Full respiratory protection should be worn by fire parties at all times.
General.....Do not permit anyone near spill unless he is suitably protected.

HEALTH HAZARD DATA

Toxic Rating: 4	Odor Threshold (ppm):	TLV (ppm): 5
Toxic Characteristics	Class B poison. Corrosive to living tissue. Absorption through skin is rapid and can cause death within 30 minutes after exposure. The vapors are also harmful. Eye contact is extremely dangerous.	
Symptoms	Headache, weakness, ringing of the ears, and irregular breathing. Skin contact will cause white, wrinkled, soft skin at site of contact.	
Short Exposure Tolerance		
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get victim to a hospital or treatment center as soon as possible. All exposure victims should get medical attention.	
General	Breathing the fumes or getting phenol on the skin can cause death in a short time.	

REACTIVITY DATA

Stability	Not dangerously reactive.
Compatibility	Aluminum and its alloys and zinc and lead are attacked by phenol.

Remarks: In order to be shipped in liquid form, it may be at elevated temperature or it may be shipped in solution with cresols.

Coast Guard Regulations require a warning sign to be displayed by barges carrying this commodity. The following is an example of acceptable wording:

DANGER: PHENOL

COMBUSTIBLE "B" POISON

NO VISITORS

NO SMOKING OR OPEN LIGHTS.

PHOSPHORIC ACID

Synonyms	: Orthophosphoric Acid	Formula..... H_3PO_4
Appearance-Odor:	Clear, syrupy liquid; practically odorless	Boiling Point..... $260^{\circ}C(500^{\circ}F)^*$ (approximate)
Chemical Family:	Acid	Vapor Pressure.....0.02 mm Hg
		Vapor Density.....
		Freezing Point..... $61^{\circ}C(108^{\circ}F)^*$
		Solubility in Water..Complete
		Specific Gravity.....1.8*

POLLUTION HAZARD DATA

Aquatic Life	Lower tolerable pH limit for most fish is 5 and for the most resistant species, 4. At pH 5, specialized flora and fauna are reported to develop.
Domestic Use	Excessive acidity may cause corrosion, affect taste, decrease efficiency of chlorination, and treatment processes, such as coagulation. Water is reported to acquire a "sour" taste below pH 3.9, except in highly buffered solutions. The taste threshold for trisodium phosphate is 225 mg/l. A concentration of 450 mg/l phosphate may cause diarrhea.
Agricultural Use	Low pH may be detrimental, depending on the nature of soil and crop.
Industrial Uses	Low pH may cause corrosion and is detrimental to many operations. Phosphate may be harmful to certain operations.

POLLUTION CONTROL MEASURES

Domestic Supply	Neutralize with sufficient alkali to prevent taste, corrosion or interference with water treatment. Temporarily shut down supply when concentration of phosphate is above taste threshold value.
Agriculture	Temporarily shut down supply or neutralize with sufficient alkali when low pH of surface water may corrode distribution system or harm crop.
Industry	Neutralize with sufficient alkali or temporarily shut down supply when pH of surface water is low (corrosive of distribution system and equipment).

Temporarily shut down supply in industries such as brewing and food which may be adversely affected by excess phosphate concentration.

FIRE & EXPLOSION HAZARD DATA

Grade.....Nonflammable liquid
Flash Point.....
Flammable Limits, %.....
Autoignition Temp.....
Extinguishing Media.....
Special Fire Procedures....
General.....Reacts with many metals, giving off hydrogen gas which is highly flammable. If hydrogen is trapped in a confined space it can form an explosive mixture with air. See data sheet for hydrogen.

HEALTH HAZARD DATA

Toxic Rating: 3	Odor Threshold (ppm):	TLV (ppm): 1 mg/m ³ **
Toxic Characteristics	The acid may cause skin burns and severe eye damage. Because of the low vapor pressure, the vapors present little hazard.	
Symptoms	Irritation of skin in contact with liquid; burning of eyes.	
Short Exposure Tolerance		
Exposure Procedures	Skin contact - remove contaminated clothing and flush affected areas gently with large amounts of water. Eye contact - immediately flush eyes gently with water; continue to flush for 15 minutes. Get medical attention.	

REACTIVITY DATA

Stability	Stable
Compatibility	Hot phosphoric acid attacks most metals.

* The information given is for 100% H₃PO₄. The most common strengths are 75%,

80% and 85% aqueous solutions. For these concentrations the specific gravity is lower and the other physical properties vary widely.

** The TLV is given for acid as a mist or spray.

PROPANE

Synonyms	: Dimethylmethane	Formula.....C ₃ H ₈
Appearance-Odor:	Colorless gas or liquid; natural-gas odor	Boiling Point.....-42°C(-44°F)
Chemical Family:	Hydrocarbon	Vapor Pressure.....6800 mm Hg
		Vapor Density.....1.55
		Freezing Point.....-187°C(-305°F)
		Solubility in Water..Negligible
		Specific Gravity.....(liq.) 0.53

POLLUTION HAZARD DATA

Aquatic Life	No toxicological data is available. However, material should quickly dissipate from water due to its low solubility, boiling point and density.
Domestic Use	Material should not enter intake because of above mentioned properties.
Agricultural Use	Material should not enter intake because of above mentioned properties.
Industrial Uses	Material should not enter intake because of above mentioned properties.

POLLUTION CONTROL MEASURES

Domestic Supply	Treatment is not generally required.
Agriculture	Treatment is not generally required.
Industry	Treatment is not generally required.

FIRE & EXPLOSION HAZARD DATA

Grade.....	LIG (Liquefied Flammable Gas)
Flash Point.....	Gas
Flammable Limits, %.....	2.2 - 9.5
Autoignition Temp.....	466°C(871°F)
Extinguishing Media.....	Stop flow of gas; CO ₂ , dry chemical, water fog.
Special Fire Procedures.....	Tanks exposed to fire should be kept cool with a continuous spray of water.
General	Shut off the fuel (gas) supply. Otherwise, putting out the fire will permit the accumulation of an explosive concentration of vapor. Secure all ignition sources.

HEALTH HAZARD DATA

Toxic Ratings: 2	Odor Threshold (ppm): *	TLV (ppm): 1000
Toxic Characteristics	The gas acts as an asphyxiant, diluting the oxygen content of the air to below that needed to sustain life. Contact with the liquid will cause frostbite.	
Symptoms	Headache, dizziness, drowsiness.	
Short Exposure Tolerance	A vapor concentration of 10,000 ppm for brief periods has produced no symptoms.	
Exposure Procedures	Remove victim to fresh air. Give artificial respiration if breathing stops. Get medical attention. If liquid has spilled onto the skin, the areas touched will probably be frostbitten and should be handled gently. All cases of frostbite should receive medical attention.	

REACTIVITY DATA

Stability	Stable
Compatibility	

Remarks: *NOTE: Exposure to potentially dangerous vapor concentrations can occur before the product can be detected by smell.

n-PROPYL ALCOHOL

Synonyms : n-propanol	Formula..... C_3H_7OH
Appearance-Odor: Colorless liquid; alcohol-like odor	Boiling Point..... $97.2^{\circ}C(207^{\circ}F)$
	Vapor Pressure.....10 mm Hg at $14.7^{\circ}C$
Chemical Family: Alcohol	Vapor Density.....2.07
	Freezing Point..... $-127^{\circ}C(-197^{\circ}F)$
	Solubility in Water..Complete
	Specific Gravity.....0.80

POLLUTION HAZARD DATA

Aquatic Life	Lethal range for gudgeon (a European fresh water fish) is 200 to 500 mg/l.
Domestic Use	Oral LD_{50} values of 1.9 and 3.3 g/kg of body weight have been reported for rats.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below 20 mg/l and the taste and odor threshold levels.
Agriculture	Hazard undetermined.
Industry	Treat as described above where material will cause a taste, odor or other problem.

FIRE & EXPLOSION HAZARD DATA

Grade.....B
 Flash Point..... $29^{\circ}C(85^{\circ}F)$
 Flammable Limits, %.....2.0 - 12
 Autoignition Temp..... $371^{\circ}C(700^{\circ}F)$
 Extinguishing Media..... CO_2 , dry chemical, alcohol foam, water fog.
 Special Fire Procedures.....
 General.....Secure ignition sources in case of spill.

HEALTH HAZARD DATA

Toxic Ratings: 1	Odor Threshold (ppm):	TLV (ppm):
Toxic Characteristics	The vapor has a narcotic effect. Recovery is generally rapid and complete.	

Symptoms

Short Exposure Tolerance

Exposure Procedures

Remove victim to fresh air. Apply artificial respiration if needed. For eye contact, wash eyes gently with fresh water.

REACTIVITY DATA

Stability

Stable

Compatibility

Compatible with most metals.

SULFUR

Synonyms	: Sulphur, brimstone, flowers of sulfur	Formula.....S, S ₈
		Boiling Point.....445°C(832°F)
		Vapor Pressure.....10 ⁻⁵ mm Hg
Appearance-Odor:	yellow-to-brown solid; amber liquid above 238°F; sharp choking SO ₂ fumes usually present	Vapor Density.....
		Freezing Point.....120°C(238°F)
		Solubility in Water..Negligible
		Specific Gravity.....1.8*
Chemical Family:		

POLLUTION HAZARD DATA

Aquatic Life	Liquid sulfur will solidify and sink if spill occurs. Colloidal sulfur will cause problems similar to those of other suspended solids. Suspended solids may kill fish and shellfish by causing abrasive injuries or clogging the gills and respiratory passages of various aquatic fauna. The sulfur that settles will blanket the stream bottom, killing eggs, young and food organisms, as well as destroy spawning beds. Indirectly, suspended solids may be inimical to aquatic life by reducing light penetration sufficiently to reduce photosynthesis, thereby decreasing the primary productivity upon which the fish food organisms depend. Sulfur in colloidal suspension has been found toxic to fish at levels from 1,600 - 10,000 mg/l over several hours.
Domestic Use	Colloidal sulfur should be considered as part of the overall turbidity problem. The 1962 USPHS Drinking Water Standards specify that turbidity shall not exceed 5 units. Doses of 1-4 g of pharmaceutical sulfur have been used internally as a laxative and parasiticide.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Traces of sulfur in water used for plating baths will affect the smoothness or brightness of deposits and in photographic developers will react and cause fog. Recommended limits of turbidity for some uses are as follows: beverages 12 mg/l, food products 10 mg/l, breweries 1-10 mg/l, boiler feed water 1-20 (depending on pressure), pulp and paper making 5-50 mg/l, textile 0.3-25 mg/l, and tanning 20 mg/l.

POLLUTION CONTROL MEASURES

Domestic Supply	If colloidal sulfur is present special attention should be given to coagulation system to assure removal.
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* Liquid at 129°C(265°F); density of solid sulfur is 2.

Agriculture	Hazard undetermined.
Industry	Shut down water supply or remove by treatment if colloidal sulfur is present in sufficient amount to cause problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....	C
Flash Point.....	168-188°C(335-370°F)
Flammable Limits, %.....	
Autoignition Temp.....	248-261°C(478-502°F)
Extinguishing Media.....	CO ₂ , dry chemicals, steam, water fog.
Special Fire Procedures....	Do not direct a solid stream of water into burning liquid sulfur or a steam explosion may result. When sulfur burns, sulfur dioxide is given off. This gas is highly toxic, so firefighting personnel must be provided with respiratory protection.
General.....	Sulfur in the molten state gives off hydrogen sulfide (H ₂ S) gas, which is highly flammable. The rate of gas evolution depends on conditions, particularly the amount of hydrocarbon impurities present.

HEALTH HAZARD DATA

Toxic Rating: 2	Odor Threshold (ppm): **	TLV (ppm): ***
Toxic Characteristics	The contained H ₂ S is extremely toxic; it dulls the sense of smell and may not be noticed. Sulfur dioxide (SO ₂), formed when sulfur burns, is highly irritating to mucous membranes.	
Symptoms	H ₂ S - headache, nausea, dizziness; loss of sense of smell. SO ₂ - severe eye and respiratory irritation.	
Short Exposure Tolerance		
Exposure Procedures	Remove victim to fresh air. If breathing stops, apply artificial respiration. Oxygen, administered by trained personnel, is often helpful. Body contact with hot liquid sulfur can cause severe scalding. Do not try to remove the solidified sulfur from such a burn. Get medical attention.	

REACTIVITY DATA

Stability	Reacts with oxidizing agents and reactive metals.
Compatibility	Liquid sulfur is noncorrosive to steel, but corrodes copper and its alloys. Moist sulfur is corrosive to steel.

** Odor alone does not give adequate warning of dangerous H₂S concentrations.

***TLV for H₂S.....10 ppm

TLV for SO₂..... 5 ppm

SULFURIC ACID

Synonyms	: Oil of vitriol	Formula..... H_2SO_4
Appearance-Odor:	Colorless-to-brown, oily liquid; no odor	Boiling Point..... $151-280^\circ\text{C}$ ($304-535^\circ\text{F}$)
Chemical Family:	Acid	Vapor Pressure.....low Vapor Density.....3.40 Freezing Point..... -37 to -30°C (-34 to -21°F) Solubility in Water.....Complete Specific Gravity.....1.56-1.84

POLLUTION HAZARD DATA

Aquatic Life	Lower tolerable pH limit for most fish is 5 and for the most resistant species, 4. At pH below 5, specialized flora and fauna develop.
Domestic Use	Excessive acidity may cause corrosion, affect taste, and decrease the efficiency of chlorination, and treatment processes, such as coagulation. Water acquires a "sour" taste below pH 3.9, except in highly buffered solutions. USPHS Drinking Water Standards recommend that sulfates not exceed 250 mg/l.
Agricultural Use	Low pH can be detrimental depending on the nature of soil and crop.
Industrial Uses	Low pH may cause corrosion and is detrimental to many operations. Excessive sulfate may also cause problems.

POLLUTION CONTROL MEASURES

Domestic Supply	Neutralize with lime or other available alkali to prevent taste, corrosion or interference with water treatment. Temporarily shut down supply in case of high sulfate concentration (above 250 mg/l).
Agriculture	Neutralize with alkali or shut down supply when low pH may cause corrosion of distribution system or is harmful to crop. Temporarily shut down supply when sulfate concentration may be harmful to crop.

Industry

Neutralize with alkali or temporarily shut down supply when low pH may cause corrosion of distribution system or equipment.

Temporarily shut down supply in certain industries such as milk, brewing, ice making, carbonated beverages, sugar making and textiles, when excessive sulfate concentration may adversely affect operation.

FIRE & EXPLOSION HAZARD DATA

Grade.....Nonflammable liquid

Flash Point.....

Flammable Limits, %.....

Autoignition Temp.....

Extinguishing Media.....

Special Fire Procedures....DO NOT USE WATER to put out a fire if the water can get into concentrated sulfuric acid. In case of a fire next to a sulfuric acid tank, use respiratory protection against fumes.

General.....Reacts with many metals, giving off hydrogen gas which is highly flammable. If hydrogen is trapped in confined spaces it can form an explosive mixture with air. See data sheet for hydrogen.

HEALTH HAZARD DATA

Toxic Rating: 4

Odor Threshold (ppm):

TLV (ppm): 1 mg/m³*

Toxic Characteristics

Will cause severe burns to skin, eyes and respiratory tract.

Symptoms

The inhalation hazard is slight at ordinary temperatures. The skin on which acid is spilled may feel hot or it may sting or itch.

Short Exposure Tolerance

Exposure Procedures

Drench with water. Remove contaminated clothing and flow water onto affected area for 15 minutes. For eye contact, immediately flush eyes gently with large amounts of water for 15 minutes. Get medical attention.

REACTIVITY DATA

Stability	Avoid adding water to the acid, since a large amount of heat is produced.
Compatibility	Highly corrosive. May ignite wood and cellulose.

Remarks: * the TLV is given for acid as a mist or spray.

Coast Guard Regulations require a warning sign to be displayed by barges carrying this commodity. The following is an example of acceptable wording:

DANGER: SULFURIC ACID

CORROSIVE LIQUID

NO VISITORS

NO SMOKING OR OPEN LIGHTS

TETRAETHYL LEAD COMPOUNDS

Synonyms : Motor fuel antiknock compounds	Formula.....(C_2H_5) ₄ Pb in mixture
Appearance-Odor: Oily liquid; containing dye; pleasant, sweet odor	Boiling Point.....110°C* (230°F)*
	Vapor Pressure.....5 to 35 mm Hg
	Vapor Density.....6 to 8
Chemical Family:	Freezing Point.....-53 to -9°C (-63 to +16°F)
	Solubility in Water..0.03%
	Specific Gravity.....1.5 - 1.7

POLLUTION HAZARD DATA

Aquatic Life	Estimated safe concentration of lead tetraethyl for fish is 0.20 mg/l as lead. The 24-hour TLM for bluegill sunfish in tap water was found to be 2.0 mg/l as lead.
Domestic Use	USPHS Drinking Water Standards (1963) is 0.05 mg/l for lead. U. S. government has also established the tolerance of lead in food at 7 mg/kg.
Agricultural Use	Lead in irrigation water is toxic to certain plants. A concentration of 51.8 mg/l has been found to slightly injure sugar beets grown in sand culture. Lead nitrate in concentrations of over 50 mg/l killed oats and potato plants in one week's time. Chronic poisoning of farm animals has been caused by approximately 2 mg/l in water.
Industrial Uses	Traces of lead in metal plating baths will affect the smoothness and brightness of deposits.

POLLUTION CONTROL MEASURES

Domestic Supply	Shut off supply until lead concentration drops below 0.05 mg/l.
Agriculture	Shut off supply until lead concentration drops below level harmful to crop or stock (50 mg/l for sugar beets, etc.).
Industry	Shut off supply until concentration drops below 0.05 mg/l in food and beverage industries and below harmful levels for others.

FIRE & EXPLOSION HAZARD DATA

Grade.....A
Flash Point.....20°C (68°F)**
Flammable Limits, %.....
Autoignition Temp.....
Extinguishing Media.....CO₂, dry chemical, foam, water fog
Special Fire Procedures....Tanks exposed to fire should be kept cool with a water spray to prevent decomposition of the lead compounds. Because of the high toxicity of the compound and its combustion products, only personnel with full respiratory protection should approach the fire - ALL OTHERS SHOULD BE EVACUATED AS QUICKLY AS POSSIBLE.
General.....The mixture may contain several lead components, one or more halocarbons (ethylene dibromide, ethylene dichloride, etc.), various hydrocarbon solvents and stabilizing compounds.

HEALTH HAZARD DATA

Toxic Rating: 4	Odor Threshold (ppm):	TLV(ppm): 0.15 ag Pb/m ³
Toxic Characteristics	Class B poison. Breathing the vapors or absorption of the liquid through the skin causes lead poisoning. The effects are cumulative.	
Symptoms	Abdominal cramps, diarrhea, headache, nausea, dizziness.	
Short Exposure Tolerance		
Exposure Procedures	THERE IS NO KNOWN ANTIDOTE! Personnel MUST avoid inhaling the vapors or allowing the liquid to touch the skin. Clothing and other absorbent material touched by the liquid should be destroyed since they cannot be decontaminated. Liquid spilled onto skin should be scrubbed off with kerosene at once. Get medical attention.	

REACTIVITY DATA

Stability	Relatively stable at ambient temperatures, but decomposes above 100°C(212°F).
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Compatibility

May be carried in steel tanks. Avoid contact with oxidizing agents or concentrated acids.

Remarks: * The boiling point of a mixture will vary considerably from the value given.

**Other components in the mixture will affect the flash point and may change the grade to a B or C combustible Class B poison.

DO NOT ENTER TANK which has held lead-containing antiknock compounds. There is no decontaminating procedure known which will effectively remove the lead compounds from inside a tank.

Coast Guard Regulations require a warning sign to be displayed by barges carrying this commodity. The following is an example of acceptable wording:

DANGER: TETRAETHYL LEAD COMPOUNDS

(or DANGER: ANTI-KNOCK COMPOUNDS)

FLAMMABLE "B" POISON

NO VISITORS

NO SMOKING OR OPEN LIGHTS

TOLUENE

Synonyms	: Toluol, methyl benzene	Formula..... $C_6H_5CH_3$
Appearance-Odor	Colorless liquid; benzene-like odor	Boiling Point..... $111^{\circ}C(231^{\circ}F)$
Chemical Family:	Aromatic hydro- carbon	Vapor Pressure.....36.7 mm Hg at $30^{\circ}C$
		Vapor Density.....3.14
		Freezing Point..... $-95^{\circ}C(-139^{\circ}F)$
		Solubility in Water..10 ⁻³ %
		Specific Gravity.....0.87

POLLUTION HAZARD DATA

Aquatic Life	Concentrations of 10 to over 90 mg/l have been found lethal to fish in fresh water, depending on the temperature and the species of fish. Lower organisms have toxicity thresholds from 60 to 200 mg/l.
Domestic Use	Oral LD ₅₀ is 7 g/kg of body weight for white rats.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	Substance may cause taste, odor or other problems.

POLLUTION CONTROL MEASURES

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below 50 mg/l and the taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....	A
Flash Point.....	$7^{\circ}C(45^{\circ}F)$
Flammable Limits, %.....	1.27 - 7.0
Autoignition Temp.....	$551^{\circ}C(1026^{\circ}F)$
Extinguishing Media.....	CO_2 , dry chemical, foam, water fog
Special Fire Procedures....	Fight the same as a petroleum fire. The vapors are more toxic than those of petroleum and should be avoided. A fire should be fought in the same manner as any Grade A flammable petroleum product.
General.....	Toluene vapors are more toxic than those of comparable petroleum hydrocarbons. Secure ignition sources in case of spill.

HEALTH HAZARD DATA

Toxic Rating: 2	Odor Threshold (ppm):	TLV (ppm): 200
Toxic Characteristics	Toluene is similar to benzene in its toxic action.	
Symptoms	Nausea, dizziness and headache. The victim may appear to be drunk.	
Short Exposure Tolerance	Inhalation of 600 ppm for 3 hours has caused severe fatigue, mental confusion, nausea, dizziness and headache.	
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.	

REACTIVITY DATA

Stability	Toluene is stable.
Compatibility	Rubber exposed to toluene will swell, soften, and deteriorate. Toluene is compatible with most metals.

XYLENE

Synonyms	: Xylol*	Formula..... $C_6H_4(CH_3)_2$
Appearance-Odor:		Boiling Point.....approx. $140^{\circ}C$ ($284^{\circ}F$)
Chemical Family:	Aromatic Hydrocarbon	Vapor Pressure.....7 mm Hg
		Vapor Density.....
		Freezing Point.....
		Solubility in Water..10-2%
		Specific Gravity.....0.86 - 0.88

POLLUTION CONTROL MEASURES

Aquatic Life	Concentrations of 10 to 90 mg/l kill fish, depending on the species, temperature and isomer. The m-isomer appears to be most toxic and o-xylene least toxic.
Domestic Use	The oral LD ₅₀ value is 4.3 g per kilogram of body weight for white rats. A concentration of 0.3 to 4 mg/l of xylene causes a detectable taste or odor in water.
Agricultural Use	Insufficient information to establish hazard.
Industrial Uses	May cause taste, odor or other problems.

POLLUTION HAZARD DATA

Domestic Supply	Treat with sufficient powdered or activated carbon to reduce concentration below taste and odor threshold level.
Agriculture	Hazard undetermined.
Industry	Treat as described above where material will cause taste, odor or other problems.

FIRE & EXPLOSION HAZARD DATA

Grade.....	B
Flash Point.....	$38^{\circ}C$ ($100^{\circ}F$)
Flammable Limits.....	LEL 1%, UEL unknown (for o-xylene)
Autoignition Temp.....	$493^{\circ}C$ ($920^{\circ}F$) (for o-xylene)
Extinguishing Media.....	CO_2 , dry chemical foam, water fog
Special Fire Procedures....	A fire should be fought in the same manner as any Grade A or B petroleum product.
General.....	The vapors are more toxic than those of comparable petroleum products. In case of spill, secure ignition sources.

HEALTH HAZARD DATA

Toxic Ratings: 2	odor Threshold (ppm):	TLV (ppm): 200
Toxic Characteristics	Xylene is similar to benzene in its toxic action.	
Symptoms	Dizziness, nausea, headache	
Short Exposure Tolerance		
Exposure Procedures	Vapor - remove victim to fresh air; if breathing stops, apply artificial respiration. Skin or eye contact - remove contaminated clothing and gently flush affected areas with water for 15 minutes. Get medical advice or attention.	

REACTIVITY DATA

Stability	Xylene is stable
Compatibility	Softens rubber. Not corrosive to most metals.

*Xylene is a mixture of three isomers; ortho, meta and para. The physical, fire and toxic properties will vary depending on the composition. Usually the meta and para isomers predominate.

APPENDIX

CROSS-REFERENCE TO COMPOUNDS

Most chemicals have several names which are acceptable. The chemicals in this selection are listed alphabetically according to the name considered most widely used in bulk shipments.

COMPOUND

ALPHABETICAL LISTING

A

Acetaldehyde
Acetic acid
Acetic anhydride
Acetic oxide
Acetone
Acetonitrile
Acrylonitrile
Alcohol
Aminobenzene
Ammonia
i-Amyl acetate
Aniline
Aniline oil
Aqueous hydrogen fluoride
Asphalt

Acetaldehyde
Acetic acid
Acetic anhydride
Acetic anhydride
Acetone
Acetonitrile
Acrylonitrile
Ethyl alcohol
Aniline
Ammonia
i-Amyl acetate
Aniline
Aniline
Hydrofluoric acid
Asphalt

B

Banana oil
Benzene
Benzol
Brimstone
Bunker "C"
Butane
Butanol
2-Butanone
n-Butyl alcohol

i-Amyl acetate
Benzene
Benzene
Sulfur
Bunker "C"
Butane
n-Butyl alcohol
Methyl ethyl ketone
n-Butyl alcohol

C

Carbolic acid
Carbon bisulfide
Carbon disulfide

Phenol
Carbon disulfide
Carbon disulfide

COMPOUND

ALPHABETICAL LISTING

C

Carbon tetrachloride
Caustic potash
Caustic soda
Chlorine
Chloroform
Chloromethane
Coal naphtha
Coal oil
Compound 497
Cresol
Cresylic acid
Crude oil
Crude petroleum

Carbon tetrachloride
Caustic potash
Caustic soda
Chlorine
Chloroform
Methyl chloride
Benzene
Kerosine
Dieldrin
Cresol
Cresol
Crude oil
Crude oil

D

1, 2-Diaminoethane
Dieldrin
Diesel oil
Dimethylbenzene
Dimethylketone
Dimethylmethane

Ethylene diamine
Dieldrin
Diesel oil
Xylene
Acetone
Propane

E

Earth oil
Ethanal
1, 2-Ethanediamine
Ethanenitrile
Ethanoic acid
Ethanol
Ethylene diamine
2-Ethylhexanol
2-Ethylhexyl alcohol

Crude oil
Acetaldehyde
Ethylene diamine
Acetonitrile
Acetic acid
Ethyl alcohol
Ethylene diamine
2-Ethylhexanol
2-Ethylhexanol

F

Flowers of sulfur
Fluorine monoxide
Formaldehyde solutions
Formalin
Fuel oil No. 1

Sulfur
Oxygen difluoride
Formaldehyde solutions
Formaldehyde solutions
Kerosine

COMPOUNDALPHABETICAL LISTING

F

Fuel oil No. 2
Fuel oil No. 6
Fuming sulfuric acid
Furfural
Furfuraldehyde
Furfurool

Diesel oil
Bunker "C"
Oleum
Furfural
Furfural
Furfural

G

Gas oil
Gasoline
Glycerine
Glycerol

Diesel oil
Gasoline
Glycerin
Glycerin

H

HEOD
1,2,3,4,10,10-hexachloro-6,
7-epoxy-1,4,4a,5,6,7,8,8a-
octahydro-1,4-endo-exo-5,8-
dimethanonaphthalene
Hydrochloric acid
Hydrochloric acid, anhydrous
Hydrofluoric acid
Hydrogen
Hydrogen chloride

Dieldrin

Dieldrin
Hydrochloric acid
Hydrogen chloride
Hydrofluoric acid
Hydrogen
Hydrogen chloride

K

Kerosine

Kerosine

L

LH₂
Lye

Hydrogen
Caustic soda

M

Methyl benzene
Methyl chloride
Methyl cyanide
Methylene oxide
Methyl ethyl ketone
MEK
Monohydroxybenzene

Toluene
Methyl chloride
Acetonitrile
Formaldehyde
Methyl ethyl ketone
Methyl ethyl ketone
Phenol

COMPOUNDALPHABETICAL LISTING

M

Motor fuel antiknock compounds
Muriatic acid

Tetraethyllead compounds
Hydrochloric acid

N

Naphthalene
Nitrogen dioxide
Nitrogen peroxide
Nitrogen tetraoxide
NTO
Normal butane

Naphthalene
Nitrogen tetraoxide
Nitrogen tetraoxide
Nitrogen tetraoxide
Nitrogen tetraoxide
n-Butane

O

Octyl alcohol
Oil of vitriol
Oleum
Orthophosphoric acid
Oxygen difluoride

2-Ethylhexanol
sulfuric acid
Oleum
Phosphoric acid
Oxygen difluoride

P

Pear oil
Petrol
Petroleum
Petroleum pitch
Phenol
Phenylamine
Phosphoric acid
Potassium hydroxide
Propane
1,2,3-propanediol
n-Propanol
Propanone
Propenenitrile
n-propyl alcohol

i-Amyl acetate
Gasoline
Crude oil
Asphalt
Phenol
Aniline
Phosphoric acid
Caustic potash
Propane
Glycerin
n-Propyl alcohol
Acetone
Acrylonitrile
n-Propyl alcohol

R

Range oil

Kerosine

COMPOUND

ALPHABETICAL LISTING

S

Seneca oil
Sodium hydroxide
Sulfur
Sulphur
Sulfuric acid

Crude oil
Caustic soda
Sulfur
Sulfur
Sulfuric acid

T

Tetrachloromethane
Tetraethyl lead compounds
Toluene
Toluol
Trichloromethane

Carbon Tetrachloride
Tetraethyl lead compounds
Toluene
Toluene
Chloroform

V

Vinegar acid
Vinyl cyanide

Acetic acid
Acrylonitrile

X

Xylene
Xylol

Xylene
Xylene